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National Trends in Sexually Transmitted Infections among Married Couples in India from 2006 to 2016: a repeated cross-sectional multivariate analysis from nationally representative data

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Objective: To assess the changes in the prevalence of past-year sexually transmitted infections (STI) and its symptoms among married couples between 2006 and 2016 in India, overall, and by socio-economic status.
Design: This study utilizes the two most recent waves (2005-2006 vs. 2015-2016) of nationally representative health surveys in India. We examined the trends of self-reported STI cases and symptoms among married couples aged 15-49 by overall and by socio-economic status. Adjusted logistic regression was used to assess the trends, accounting for covariates, and the complex survey design.
Setting: Cross-sectional, nationally representative population-based survey in 2005-2006 and 2015-2016 from National Family Health Survey data from Demographic and Health Survey.
Participants: 39,257 married couples aged 15-49 for 2005-2006 survey wave and 63,696 married couples aged 15-49 for 2015-2016 wave.
Outcome measure: Self-reported STI was used as primary outcome measures.
Results: In 2016, 2.5% of married women reported having had an STI in the past year, a significant increase from 1.6% in 2006 ($p<0.001$). The past-year STI prevalence among married men significantly increased from 0.5% in 2006 to 1.1% in 2016 ($p<0.001$). Adjusted results showed that the uptrend of couples' STI was more significant among those whose husbands are currently employed, and those families in middle or higher wealth quintiles. Alarmingly, among couples who reported STI or symptoms, they were less likely to seek advice or treatment in 2016 as compared to 2006 (aOR=0.50, $p<0.001$, 95% CI=0.40, 0.61).
Conclusion: The study identifies a substantial uptrend of STI prevalence with a notable treatment seeking gap among married couples in India over the past decade.

Article Summary

Strengths and Limitations of this study

- Utilizes a large nationally representative health survey to assess the relationship between STI and various socio-demographic factors in India
- Examines the trend of STIs prevalence among married couples with the two most recent data available
- Cross-sectional data limits causal inference
- Survey data may suffer from self-reporting bias

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INTRODUCTION

The epidemic of sexually transmitted infections (STI) is a growing global concern.[1] A report from the WHO estimates that there are 357 million newly diagnosed STI cases each year.[2] STIs come in a bacterial or viral form and can cause symptoms that affect, not only morbidity and mortality, but mental health, psychosocial wellbeing, family relation, and the overall quality of life.[3–5] Negative consequences of STI and symptoms present a significant public health challenge, especially in low- to middle-income countries with limited health system infrastructure.[1,3,6]

Socio-demographic factors and economic conditions are associated with the prevalence of STI to a varying degree. Certain groups are more vulnerable to STI, and these demographic factors include education, wealth, rurality, and other socio-demographic and economic conditions in developing countries.[7–13] Among these countries, India is currently undergoing a profound epidemiologic transition amid rapid economic development. Preliminary evidence from regional studies suggests an increase in STI prevalence in certain vulnerable social groups, like those below primary education level, illiteracy, and unemplyment.[14–16] Another study, which used the data from 1998 wave of the National Family Health Survey (NFHS) and two waves of 1998 and 2002 waves of the District Level Household Survey – Reproductive and Child Health (DLHS-RCH), reported that rural women, muslim, illiterate, and whose marriage occurred at a very young age of less than 18 years old had a higher STI prevalence.[17]

To date, there is a gap in the literature that examines the trends of STI prevalence in recent years in India, particularly among married couples over time. Available literatures on STI trends in India tend to focus on high-risk groups, such as female sex workers and men who have sex with men.[18–22] Existing literature that assesses STI prevalence among married couples in India are only reporting on one timepoint without time-trend epidemiological analyses.[23–25] Most of the aforementioned studies have been restricted to specific regions of India, thus the findings are not generalizable to describe the national trend of STI and not adequate to inform whether there have been differential impacts of STI trend on specific subpopulations.

This study analyzes two recent waves of India's NFHS spanning over a decade to assess the trend of STIs prevalence among married couples and examine whether there are differential trends based on the married couples' socio-demographic factors, such as education, religion, rural, and wealth. This study provides further evidence of differential patterns of STI across various demographic and socio-economic conditions through nationally representative samples in the last decade, where there has been profound economic development and epidemiologic transition in India.

METHODS

India NFHS is part of the Indian Demographic and Health Survey (DHS), which is a nationally representative household-based health surveillance system. This study used the nationally representative sample of married couples aged 15-49 from two different waves in 2005-06 NFHS-3 (N=39,257) and 2015-16 NFHS-4 (N=63,696) . The overall response rates were more than 95% for both waves of the survey.[26,27] Both NFHS-3 and NFHS-4 conducted household surveys in states and union territories of India.

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In both NFHS cycles, respondents were asked *if they have ever had sex* and were asked *whether they had an STI or symptoms of an STI in the last 12 months*. STI symptoms were categorized as follows: a bad-smelling, abnormal discharge from the vagina/penis, a genital sore, or a genital ulcer. The survey did not specify the diseases of STI diagnoses. For the analyses, the STI/STI symptom outcomes were categorized as such if the respondents either had reported STI and/or STI symptoms in the past year. For this study, we grouped the STI prevalence of at least one of the married couples as a single dichotomous variable to code as the primary STI outcome of a couple. Among those who reported STI or symptoms, the survey asked whether they sought advice or treatment when they had STI/discharge/sore/ulcer in the past year. In this paper, we also used married individuals' treatment or seeking advice for STI or its symptoms as a separate outcome. We used self-reported STI status as a primary outcome in our multivariate analysis.

The year was coded as an indicator variable with data from wave 2016 coded as 1 and those from wave 2006 coded as 0. We used covariates that were individually reported by wife and husband, such as age, education (college or above, higher secondary, secondary, primary, illiterate), current employment status, religion (Hindu, Muslim, Christian, and other), family wealth (highest, fourth, middle, second, lowest), and family residence (urban, rural). For education, the higher secondary education group is for grades 11 and 12; the secondary education group is for grades 9 and 10; the primary education for grades 1 to 8. The coding of these covariates was based on prior literature.[28] Due to a small number of incidence in each level, the caste variable was not included in the bivariate and multivariate analyses. For the NFHS couple data set, we used sampling weights of men from both waves that represent the respective population and its distribution at the national level. All statistical analyses were performed using software SAS. Because we used secondary, publicly available data sources without personal identifiers, this is not deemed to be human subjects research.

Prevalence of STI and symptoms were calculated for husband, wife, and couple for 2006 and 2016. Both bivariate and multivariate analyses have been conducted for this study. For this study, we used individualized socio-economic and demographic factors as the predictor variables to assess their associations with STI. With bivariate analysis, we estimated associations between individual demographic and socio-economic characteristics and the couple's STI status. Multiple logistic regressions with complex survey procedures were used to model predictors of couple STI. Similar approaches were also used for an individual's treatment or seeking advice for STI. To assess the time trend, we used the year as a categorical variable using 2006 as the reference year to assess the main effect of the trend from 2006 to 2016. To determine differential trends by demographics and SES status, we evaluated the interaction terms of the trend variable and these key covariates. The backward elimination procedure was used to identify significant interaction terms by removing terms from the multivariate logistic regression model with a threshold of p-value greater or equal to 0.05. Statistical significance was determined by p-value < 0.05.

RESULTS

Table 1 summarizes the prevalence of past-year STI and any STI symptoms as individually reported by married couples from 2006 and 2016 NFHS waves. Married women reported a significantly greater increase in self-report STI from 2006 to 2016 when compared to married

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men. In 2016, 2.5% of married women reported having had an STI in the past year, which significantly increased from 1.6% in 2006 (p<0.001). The national prevalence of past-year STI among married men increased significantly from 0.5% in 2006 to 1.1% in 2016 (p<0.001). The prevalence of STI among married couples has significantly increased from 2.06% in 2006 to 3.55% in 2016 (p<0.001). Figure 1 shows an increase in prevalence across self-report STI and other STI related symptoms from 2006 to 2016 among married couples in India.

For STI symptoms (Table 1), including genital sore and discharge, there was a significantly higher prevalence among husbands in 2016 compared to 2006. For married men, 6.2% reported having had any STI symptoms in 2016 compared to 3.9% in 2006, a substantial increase over the period (p<0.001). Married women also reported a significantly higher prevalence of an STI symptom for genital sores from 2.3% in 2006 to 3.1% in 2016 (p<0.001). Overall, the prevalence of any STI and symptoms in the past year experienced by married couples has significantly increased from 14.7% in 2006 to 17.4% in 2016 (p<0.001).

Table 2 provides a summary of bivariate and multiple logistic regressions with the couple's STI status only as the primary outcome variable. In both bivariate and adjusted models, married couples in 2016 are approximately 70% more likely to report having STI in the past year (aOR=1.72, p<0.001, 95% CI=1.49, 1.97). Mutually adjusting for the individual- and couple-level socio-demographic and SES factors, husband's education in college or above (aOR=1.37, p<0.05, 95% CI=1.08, 1.73), secondary (aOR=1.36, p<0.01, 95% CI=1.13, 1.65), and primary levels (aOR=1.22, p<0.05, 95% CI=1.03, 1.44) were significantly positively associated with the couple's STI status, relative to those who were illiterate. Although those with higher secondary education was not significantly different from those who were illiterate (aOR=1.06, p=0.599, 95% CI=0.85, 1.33). Meanwhile, age, religion, employment, family wealth, and residence were not significantly associated with STI status in couples when adjusted with other factors.

Table 3 demonstrates the time trend by socio-economic status (SES) interactions in moderating the risk of self-reporting STI in married couples. This list of socio-economic status variables includes an individual's education and employment status, and the couple's family wealth index, and residence. The first column in Table 3 shows the bivariate relationships between each trend by SES interaction term alone in predicting a couple's STI status, controlling for the main effects of age and religion, and all SES variables. In these models, married couples with employed husbands were 2.21 times (p<0.01, 95% CI=1.25, 3.88) likely to report an increase of past-year STI, and the wife's secondary education level (OR= 1.77, p<0.01, 95% CI= 1.21, 2.60) was also associated with an uptrend in reporting past-year STI. Couples in the highest or fourth quintile of family health or those in urban residence were associated with an uptrend in reporting past-year STI comparing 2006 to 2016.

The second column in Table 3 provides a summary of adjusted multivariate relationships with all trends by SES interaction terms simultaneously in predicting self-reporting STI, controlling for the main effects of age, religion, and all SES variables. For the third column in Table 3 as the final model, we implemented backward elimination procedures to retain trend by SES interaction terms that were statistically significant, adjusting for the main effects of age, religion, and all SES variables. The husband's employment was positively associated with the uptrend of the married couple's report of past-year STI from 2006 to 2016 (aOR=1.96, p<0.05, 95% CI=1.11,

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3.48). Couples who were in the highest (aOR=2.58, p<0.001, 95% CI=1.72, 3.87), fourth quintile (aOR=2.46, p<0.001, 95% CI=1.64, 3.69), and middle quintile (aOR=1.72, p<0.01, 95% CI=1.16, 2.54) of family wealth were significantly more likely to experience an increase from 2006 to 2016 in reporting past-year STI compared to those in the lowest quintile of family wealth.

We also examined the relationship between the socio-demographic factors and treatment or seeking advice for STI or symptoms in the past 12 months. Using the multivariate analysis, we calculated the adjusted odds ratios for married individuals' likelihood of receiving treatment or seeking advice after accounting for all the demographics and socio-economic status. For the multivariate-adjusted model, husbands who had recent STI or symptoms in 2016 were significantly less likely (aOR=0.50, p<0.001, 95% CI=0.40, 0.61) to receive treatment or advice compared to those in 2006. Husbands with family wealth in the second quintile (aOR= 1.29, p<0.05, 95% CI=1.02, 1.64) compared to those in the lowest quintile were more likely to receive treatment or seek advice. Other factors, such as age, education level, employment, religion, and residence, were not significantly associated with the husband's treatment or seeking advice for STI and symptoms in this adjusted multivariate model.

For the next adjusted model, wives in 2016 had an adjusted odds ratio of 0.89 (p<0.05, 95% CI=0.78, 0.98) that was significantly less likely to receive treatment or seek advice for STI and symptoms when compared to 2006. Wives were more likely to receive treatment or seek advice when they had higher secondary (aOR=1.31, p<0.05, 95% CI=1.03, 1.66), secondary (aOR=1.47, p<0.001, 95% CI=1.22, 1.77), primary (aOR=1.40, p<0.001, 95% CI=1.23, 1.60) education level compared to those who were illiterate. Wives whose husband had higher secondary (aOR=1.28, p<0.05, 95% CI=1.02, 1.61), secondary (aOR=1.21, p<0.05, 95% CI=1.01, 1.46), and primary (aOR=1.21, p<0.05, 95% CI=1.03, 1.42) education level were also more likely to receive treatment or seek advice. Wives who were employed were significantly more likely to seek treatment or seek advice (aOR=1.15, p<0.05, 95% CI=1.01, 1.28). For family wealth, wives in the highest (aOR=1.49, p<0.001, 95% CI=1.49, 2.34), fourth (aOR=1.67, p<0.001, 95% CI=1.38, 2.03), and middle (aOR=1.34, p<0.01, 95% CI=1.11, 1.61) quintiles were significantly more likely to receive treatment or seek advice compared to those in lowest family wealth quintile when adjusted with other socio-demographic variables. Other factors, such as age, religion, and residence, were not significantly associated with the wife's treatment or seeking advice for STI and symptoms in this adjusted multivariate model.

DISCUSSION

The results from the analyses identify a significant uptrend of self-reporting STI prevalence among both married men and women over the past decade in India. In 2016, 2.5% of married women reported having had an STI in the past year, which significantly increased from 1.6% in 2006. Adjusted results showed that the uptrend of couples' self-reporting STI was more significant among those whose husbands are currently employed, and those families in middle or higher wealth quintiles. Alarmingly, among couples who reported STI or symptoms, both husband and wife were less likely to seek advice or treatment in 2016 as compared to 2006.

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Our study utilizes the two latest datasets from a large nationally representative health survey to assess the relationship between STI and various socio-demographic factors in India. To the best of our knowledge, this is the first study that describes the trend of STI prevalence among married couples in India from 2006 to 2016 and assesses whether the trends vary by socio-demographic and economic conditions. Our findings are different from the cross-sectional results of a past similar study based on a single wave of India national survey data of 1998, that showed that the rural women, muslim, and illiterate women had a higher STI prevalence.[17] With the newer datasets from 2006 and 2016, our analysis revealed a new finding that married couples with currently employed husbands and with middle or higher wealth are associated with greater odds of self-report of STI. With rising disposable income due to rapid economic development in India in the past decades, it is possible that the availability of disposable economic resources may have increased the likelihood of risky sexual behaviors. There is evidence that in some epidemiological studies of HIV that wealthier individuals may engage in risky sexual behaviors to increase their vulnerability to infections.[29,30] Other work in Uganda has found that the middle wealth quintile and disposable income posed higher risk for STI.[31] According to our findings, wives with middle or higher household wealth were more likely to seek advice or treatment for STI compared to those with lower wealth. A combination of these two factors may have contributed to the higher rates of self-report STIs among wealthier group. It is unclear that these changes in family dynamics may contribute to intimate partner relationships and subsequently affect sexual health among married couples.

Since this study used only a limited number of socio-demographic factors in the adjusted multivariate analysis, the contextual background behind these socio-economic indicators included in this study may need to be further examined. Further study is warranted to ascertain associations between couples' STI and socio-demographics after accounting for another individual, family, and state covariates. Also, the decreased prevalence of seeking advice or treatment for STI in 2016 compared to 2006 suggests that the sexual healthcare utilization is still minimal in India. Studies in India suggests that gender relations, geography, and social networks are often associated with women’s health seeking behavior for STI.[32,33] Therefore, further research is warranted to include cultural and geospatial differences and access to treatment.

There are several limitations to our study. Although the NFHS followed a rigorous and established data collection methodology, there may be self-report bias. According to the interviewer's manual, the survey interviewers administering the NFHS are culturally trained to build rapport, establish safe and private setting, and assure confidentiality to the respondents.[34] Despite these efforts, survey respondents may have still misreported their STI status due to the sensitive nature, cultural stigma, and social undesirability associated with STI. Compared to clinical data gathered from STI laboratory tests, self-reported STI status may have been underreported or misreported. There is also a possibility of recall bias due to a longer time interval for the period of the past 12 months for STI incidence.

Although our analyses use the latest available datasets of two different time points, it should be noted that there is a limitation in assessing trends between only two-time points. The cross-sectional design is limited to causal inference. Furthermore, we observed small cell counts across caste categories, so we have excluded that variable from our analyses. It is possible that the exclusion of caste as covariates in our analyses may have introduced residual confounding.

Because the focus of the current investigation is on demographic and socio-economic conditions, there may be additional residual confounding due to unobserved factors.

Evaluating the relationship of socio-demographic determinants and STI rates among married couples can be valuable for programmatic and policy decisions for community-based clinical care to improve sexual health outcomes for married individuals. The prevention and intervention models for sexual health in communities in India should consider the multitude of social factors that may put certain groups of individuals at greater risk for infections than others.

Contributors
J. Choi performed the analyses, interpreted the results, and led the writing. Z. Xuan conceived of the study and supervised all aspects of the study. D. Bahl and M. Arora contributed significantly to the interpretation of findings and review of the article.

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Data sharing statement
Datasets for the analyses were obtained from Demographic and Health Survey (DHS) and is freely available online at DHS website.

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Table 1. Prevalence of past-year STI and STI symptoms by married couples' self-reports, India National Family Health Survey, 2006 - 2016.

		STI % (SE)	**Any STI symptoms** % (SE)	**- Genital Sore** % (SE)	**- Genital Discharge** % (SE)	**Any STI and symptoms** % (SE)
2006	Husband	0.50 (0.06)	3.89 (0.19)	2.14 (0.13)	2.36 (0.14)	4.07 (0.19)
	Wife	1.58 (0.11)	11.02 (0.28)	2.27 (0.12)	10.10 (0.26)	11.32 (0.28)
	Couple	2.06 (0.12)	14.22 (0.32)	4.29 (0.17)	12.11 (0.29)	14.72 (0.32)
2016	Husband	1.07 (0.06)	6.22 (0.22)	2.56 (0.11)	4.62 (0.20)	6.75 (0.22)
	Wife	2.52 (0.11)	10.63 (0.22)	3.14 (0.12)	9.59 (0.21)	11.57 (0.23)
	Couple	3.55 (0.13)	16.05 (0.30)	5.58 (0.16)	13.65 (0.28)	17.40 (0.30)
		STI Chi-square (p-value)	**Any STI symptoms** Chi-square (p-value)	**- Genital Sore** Chi-square (p-value)	**- Genital Discharge** Chi-square (p-value)	**Any STI and symptoms** Chi-square (p-value)
2006 vs. 2016	Husband	38.67***	61.22***	5.59*	85.35***	78.23***
	Wife	32.78***	1.23	24.68***	2.26	0.45
	Couple	63.93***	17.24***	28.32***	14.36***	36.37***

*p<0.05
**p<0.01
***p<0.001
SE= Standard Error

Figure 1. Prevalence (%) of married couple's recent STI and STI symptoms by years, 2006 and 2016.

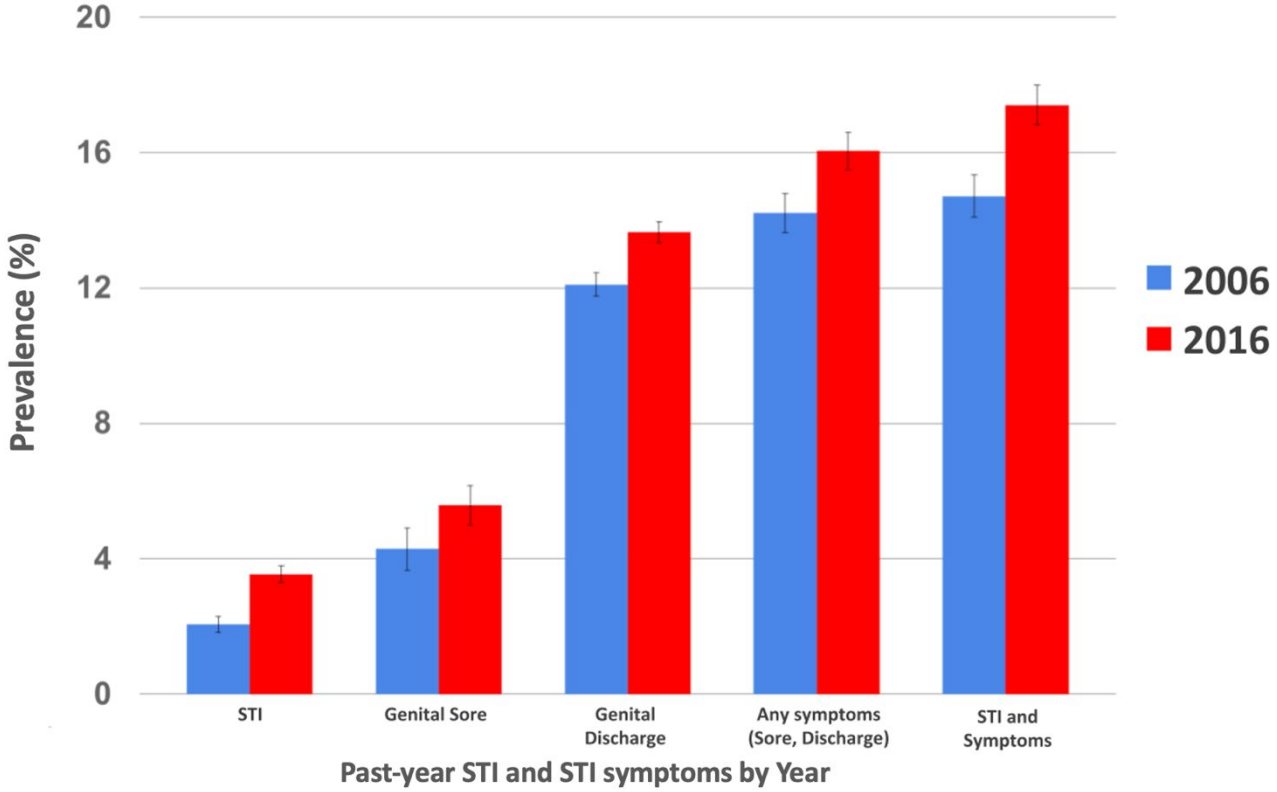

Table 2. Associations of married couples' current STI status with individual's demographics and socio-economic status.

	Couple's STI (Bivariate) OR (95% CI)		**Couple's STI (Multivariate)** Adjusted OR (95% CI)	
Year 2016	1.75***	(1.52, 2.01)	1.72***	(1.49, 1.97)
2006	Ref.		Ref.	
Wife's age	1.00	(0.99, 1.01)	1.01	(0.99, 1.02)
Wife's education				
- College or above	1.56***	(1.22, 2.00)	1.12	(0.84, 1.48)
- Higher secondary	1.43***	(1.17, 1.74)	1.09	(0.86, 1.38)
- Secondary	1.19*	(1.01, 1.40)	0.94	(0.78, 1.14)
- Primary	1.05	(0.92, 1.20)	0.90	(0.78, 1.03)
- Illiterate	Ref.		Ref.	
Wife's employment	0.95	(0.84, 1.07)	1.10	(0.96, 1.25)
Wife's religion				
- Hindu	0.92	(0.70, 1.22)	1.01	(0.63, 1.63)
- Muslim	1.13	(0.83, 1.54)	1.02	(0.55, 1.90)
- Christian	0.87	(0.56, 1.34)	0.93	(0.41, 2.10)
- Other	Ref.		Ref.	
Husband's age (years)	1.00	(0.99, 1.00)	0.99	(0.98, 1.01)
Husband's education				
- College or above	1.67***	(1.34, 2.08)	1.37*	(1.08, 1.73)
- Higher secondary	1.21	(1.00, 1.47)	1.06	(0.85, 1.33)
- Secondary	1.47***	(1.23, 1.75)	1.36**	(1.13, 1.65)
- Primary	1.25**	(1.07, 1.46)	1.22*	(1.03, 1.44)
- Illiterate	Ref.		Ref.	
Husband's employment	0.90	(0.72, 1.14)	0.96	(0.76, 1.22)
Husband's religion				
- Hindu	0.92	(0.69, 1.23)	0.94	(0.57, 1.55)
- Muslim	1.14	(0.83, 1.57)	1.21	(0.64, 2.29)
- Christian	0.87	(0.55, 1.37)	0.91	(0.39, 2.12)
- Other	Ref.		Ref.	
Family wealth				
- Highest	1.42***	(1.17, 1.73)	1.23	(0.98, 1.56)
- Fourth	1.23*	(1.02, 1.48)	1.13	(0.91, 1.39)
- Middle	1.17	(0.97, 1.40)	1.10	(0.91, 1.32)
- Second	1.09	(0.91, 1.30)	1.05	(0.87, 1.26)
- Lowest	Ref.		Ref.	
Family residence				
- Urban	1.15	(1.00, 1.31)	0.98	(0.84, 1.14)
- Rural	Ref.		Ref.	

*p<0.05
**p<0.01
***p<0.001
OR = Odds Ratio
95% CI = 95% Confidence Intervals
Ref. = Reference groups for odds ratios

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Table 3. Interaction terms between year trend and individual's demographics and socio-economic status in predicting married couples' current STI status, 2006 and 2016.

Interaction terms between year and each of the following predictors	Couple's STI[a] OR (95% CI)		Couple's STI[b] Adjusted OR (95% CI)		Couple's STI[d] Adjusted OR (95% CI)	
Wife's education						
- College or above	1.49	(0.91, 2.42)	1.36	(0.72, 2.57)		
- Higher secondary	0.99	(0.64, 1.53)	1.04	(0.60, 1.80)		
- Secondary	1.77**	(1.21, 2.60)	1.84**	(1.17, 2.90)		
- Primary	1.15	(0.87, 1.51)	1.35	(0.98, 1.86)		
- Illiterate	Ref.		Ref.			
Wife's employment	1.11	(0.85, 1.45)	1.27	(0.96, 1.68)		
Husband's education						
- College or above	1.43	(0.97, 2.10)	0.99	(0.56, 1.75)		
- Higher secondary	1.06	(0.72, 1.57)	0.88	(0.52, 1.48)		
- Secondary	1.22	(0.91, 1.64)	1.03	(0.68, 1.57)		
- Primary	0.89	(0.69, 1.14)	1.04	(0.73, 1.48)		
- Illiterate	Ref.		Ref.			
Husband's employment	2.21**	(1.25, 3.88)	1.92*	(1.08, 3.40)	1.96*	(1.11, 3.48)
Family wealth						
- Highest	1.65**	(1.21, 2.24)	2.07**	(1.21, 3.54)	2.58***	(1.72, 3.87)
- Fourth	1.48*	(1.09, 2.00)	2.05**	(1.28, 3.29)	2.46***	(1.64, 3.69)
- Middle	0.95	(0.70, 1.27)	1.53*	(1.02, 2.30)	1.72**	(1.16, 2.54)
- Second	0.73*	(0.55, 0.98)	1.32	(0.89, 1.96)	1.41	(0.96, 2.07)
- Lowest	Ref.		Ref.		Ref.	
Family residence						
- Urban	1.56**	(1.16, 2.09)	1.11	(0.79, 1.57)		
- Rural	Ref.		Ref.			

*p<0.05
**p<0.01
***p<0.001
OR = Odds Ratio
95% CI = 95% Confidence Intervals
Ref. = Reference groups for odds ratios

[a]Unadjusted bivariate analysis for all predictors included in the table, including age and religion

[b]Adjusted multivariate analysis for all predictors included in the table, including age and religion

[c]Multivariate analysis for SES variables (employment, family wealth) as predictors and adjusted to all predictors included in the table, including age and religion

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Table 4. Associations of likelihood of married couples, who reported STI or symptoms, seeking advice or treatment when they had STI/discharge/sore/ulcer and individual's demographics and socio-economic status, 2006 and 2016.

	Husband's treatment or seeking advice for STI and symptoms (Multivariate) Adjusted OR (95% CI)		**Wife's treatment or seeking advice for STI and symptoms (Multivariate)** Adjusted OR (95% CI)	
Year 2016	0.50***	(0.40, 0.61)	0.89*	(0.78, 0.98)
2006	Ref.		Ref.	
Wife's age	1.01	(0.98, 1.03)	1.00	(0.99, 1.02)
Wife's education				
- College or above	1.48	(0.96, 2.28)	1.26	(0.95, 1.68)
- Higher secondary	1.29	(0.88, 1.87)	1.31*	(1.03, 1.66)
- Secondary	1.12	(0.84, 1.48)	1.47***	(1.22, 1.77)
- Primary	0.92	(0.75, 1.13)	1.40***	(1.23, 1.60)
- Illiterate	Ref.		Ref.	
Wife's employment	1.01	(0.84, 1.21)	1.14*	(1.01, 1.28)
Wife's religion				
- Hindu	1.22	(0.55, 2.67)	0.98	(0.58, 1.66)
- Muslim	1.52	(0.51, 4.54)	1.52	(0.72, 3.20)
- Christian	0.47	(0.18, 1.25)	1.15	(0.56, 2.36)
- Other	Ref.		Ref.	
Husband's age	1.00	(0.98, 1.02)	1.01	(0.99, 1.02)
Husband's education				
- College or above	0.94	(0.64, 1.39)	1.25	(0.97, 1.59)
- Higher secondary	0.85	(0.59, 1.23)	1.28*	(1.02, 1.61)
- Secondary	1.02	(0.75, 1.39)	1.21*	(1.01, 1.46)
- Primary	0.97	(0.76, 1.23)	1.21*	(1.03, 1.42)
- Illiterate	Ref.		Ref.	
Husband's employment	1.04	(0.78, 1.39)	1.11	(0.90, 1.38)
Husband's religion				
- Hindu	0.70	(0.32, 1.51)	0.72	(0.42, 1.25)
- Muslim	0.91	(0.31, 2.65)	0.56	(0.26, 1.20)
- Christian	1.05	(0.39, 2.79)	0.61	(0.30, 1.28)
- Other	Ref.		Ref.	
Family wealth				
- Highest	1.14	(0.82, 1.59)	1.87***	(1.49, 2.34)
- Fourth	1.06	(0.79, 1.44)	1.67***	(1.38, 2.03)
- Middle	1.11	(0.84, 1.46)	1.34**	(1.11, 1.61)
- Second	1.29*	(1.02, 1.64)	1.16	(0.97, 1.40)
- Lowest	Ref.		Ref.	
Family residence				
- Urban	1.12	(0.90, 1.39)	1.05	(0.92, 1.20)
- Rural	Ref.		Ref.	

*p<0.05
**p<0.01
***p<0.001
OR adjusted for all variables included in the table
OR = Odds Ratio
95% CI = 95% Confidence Intervals
Ref. = Reference groups for odds ratios

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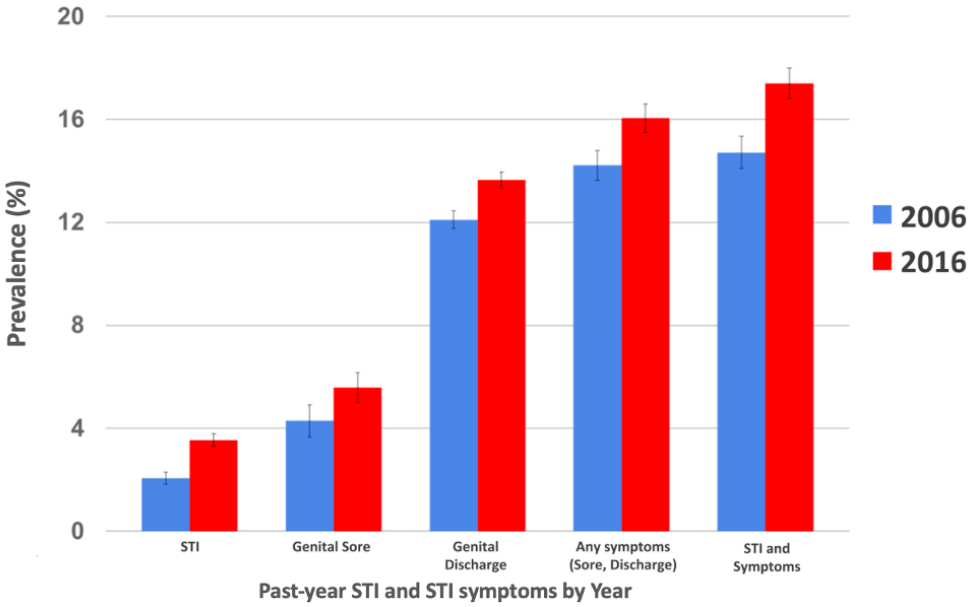

Figure 1. Prevalence (%) of married couple's recent STI and STI symptoms by years, 2006 and 2016.

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Changes in Self-Report Sexually Transmitted Infections among Married Couples in India from 2006 to 2016: A Repeated Cross-sectional Multivariate Analysis from Nationally Representative Data

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Objective: To assess the changes in prevalence of past-year STI and its symptoms among married couples between 2006 and 2016 in India, overall, and by socio-economic status.
Design: This cross- sectional study utilizes the two most recent waves (2005-2006 vs. 2015-2016) of nationally representative health surveys in India. We examined the changes of self-reported STI cases and symptoms among married couples aged 15-54 by overall and by socio-economic status. Adjusted logistic regression was used to assess the changes, accounting for covariates, and the complex survey design.
Setting: Cross-sectional, nationally representative population-based survey in 2005-2006 and 2015-2016 from National Family Health Survey data from Demographic and Health Survey.
Participants: 39,257 married couples aged 15-49 years for 2005-2006 survey wave and 63,696 married couples aged 15-49 years for 2015-2016 wave.
Outcome measure: Self-reported STI was used as primary outcome measures.
Results: In 2016, 2.5% of married women reported having had an STI in the past year, a significant increase from 1.6% in 2006 ($p<0.001$). The past-year STI prevalence among married men significantly increased from 0.5% in 2006 to 1.1% in 2016 ($p<0.001$). Adjusted results showed that the uptrend of couples' STI was more significant among those whose husbands are currently employed, and those families in middle or higher wealth quintiles. Alarmingly, among couples who reported STI or symptoms, they were less likely to seek advice or treatment in 2016 as compared to 2006 (aOR=0.50, $p<0.001$, 95% CI=0.40, 0.61).
Conclusion: The study identifies a substantial increase in STI prevalence with a notable treatment seeking gap among married couples in India over the past decade.

Article Summary

Strengths and Limitations of this study

- Utilizes a large nationally representative health survey to assess the relationship between STI and various socio-demographic factors in India
- Examines the change of STIs prevalence among married couples with the two most recent data available from 2006 to 2016
- Cross-sectional data limits causal inference
- Survey data may suffer from self-reporting bias

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INTRODUCTION

The epidemic of sexually transmitted infections (STI) is a growing global concern.[1] A report from the World Health Organization (WHO) estimates that there are 376 million newly diagnosed STI cases each year.[2] STIs come in a bacterial or viral form and can cause symptoms that affect not only morbidity and mortality but mental health, psychosocial wellbeing, family relation, and the overall quality of life.[3–5] Negative consequences of STI and symptoms present a significant public health challenge, especially in low- to middle-income countries with limited health system infrastructure.[1,3,6]

Socio-demographic factors and economic conditions are associated with the prevalence of STI to a varying degree. Certain groups are more vulnerable to STI, and these demographic factors include education, wealth, rurality, and other socio-demographic and economic conditions in developing countries.[7–13] Among these countries, India is currently undergoing a profound epidemiologic transition amid rapid economic development. Preliminary evidence from regional studies suggests increased STI prevalence in certain vulnerable social groups, like those below primary education level, illiteracy, and unemployment.[14–16] Another study, which used the data from 1998 wave of the National Family Health Survey (NFHS) and two waves of 1998 and 2002 waves of the District Level Household Survey – Reproductive and Child Health (DLHS-RCH), reported that rural women, Muslim, illiterate, and whose marriage occurred at a very young age of less than 18 years old had a higher STI prevalence.[17]

To date, there is a gap in the literature that examines the trends of STI prevalence in recent years in India, particularly among married couples over time. Available literature on STI trends in India tend to focus on high-risk groups, such as female sex workers and men who have sex with men.[18–22] Existing literature that assesses STI prevalence among married couples in India is only reporting on one timepoint without time-trend epidemiological analyses.[23–25] Most of the aforementioned studies have been restricted to specific regions of India, thus the findings are not generalizable to describe the national trend of STI and not adequate to inform whether there have been differential impacts of STI trend on specific subpopulations.

This study analyzes two recent waves of India's NFHS spanning over a decade to assess STIs prevalence among married couples and examine whether there are differential trends based on the married couples' socio-demographic factors, such as education, religion, rurality, and wealth. This study provides further evidence of differential patterns of STI across various demographic and socio-economic conditions through nationally representative samples in the last decade, where there has been profound economic development and epidemiologic transition in India.

METHODS

India NFHS is part of the Indian Demographic and Health Survey (DHS), which is a nationally representative household-based health surveillance system. This study used the nationally representative sample of married couples aged 15-54 from two different waves in 2005-06 NFHS-3 (N=39,257) and 2015-16 NFHS-4 (N=63,696). The reported rates of married couples who do not cohabitate at the time of the survey were less than 1% (female, 2006: 0.62%; female, 2016: 0.37%; male, 2006: 0.26%; male, 2016: 0.14%). The overall response rates were more than 95% for both waves of the survey.[26,27] Both NFHS-3 and NFHS-4 conducted household

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surveys in states and union territories of India. As shown in Figure 1, a sample of 102,690 couples from two survey waves were analyzed for STI analyses after excluding couples with unknown and missing STI statuses. For the multivariate analyses, a sample of 97,288 couples were analyzed after excluding couples with missing covariates.

In both NFHS waves, respondents were asked *if they have ever had sex* and were asked *whether they had an STI or symptoms of an STI in the last 12 months*. STI symptoms were categorized as follows: a bad-smelling, abnormal discharge from the vagina/penis, a genital sore, or a genital ulcer. The survey did not specify the diseases of STI diagnoses. For the analyses, the STI/STI symptom outcomes were categorized as such if the respondents either had reported STI and/or STI symptoms in the past year. For this study, we grouped the STI prevalence of at least one of the married couples as a single dichotomous variable to code as the primary STI outcome of a couple. Instead of individual prevalence, we used the couple STI prevalence as the main outcome because the STI prevalence trend for husband and wife across two waves remained similar in both waves. Among those who reported STI or symptoms, the survey asked whether they sought advice or treatment when they had STI/discharge/sore/ulcer in the past year. In this paper, we also used married individuals' treatment or seeking advice for STI or its symptoms as a separate outcome. We used self-reported STI status as a primary outcome in our multivariate analysis.

The year was coded as an indicator variable with data from wave 2016 coded as 1 and those from wave 2006 coded as 0. We used covariates that were individually reported by wife and husband, such as age, education (college or above, higher secondary, secondary, primary, illiterate), current employment status, religion (Hindu, Muslim, Christian, and other), family wealth (highest, fourth, middle, second, lowest), and family residence (urban, rural). For education, the higher secondary education group is for grades 11 and 12; the secondary education group is for grades 9 and 10; the primary education for grades 1 to 8. The coding of these covariates was based on prior literature.[28] The caste variable was categorized as scheduled caste, scheduled tribe, other backward class, and others (none of them). For the NFHS couple data set, we used sampling weights of men from both waves that represent the respective population and its distribution at the national level. All statistical analyses were performed using software SAS. Because we used secondary, publicly available data sources without personal identifiers, this study is exempted from Institutional Review Board's review and approval.

Prevalence of STI and symptoms were calculated for husband, wife, and couple for 2006 and 2016. Both bivariate and multivariate analyses have been conducted for this study. For this study, we used individualized socio-economic and demographic factors as the predictor variables to assess their associations with STI. With bivariate analysis, we estimated associations between individual demographic and socio-economic characteristics and the couple's STI status. Multiple logistic regressions with complex survey procedures were used to model predictors of couple's STI status. Similar approaches were also used for an individual's treatment or seeking advice for STI. To assess the changes over time, we used the year as a categorical variable using 2006 as the reference year to assess the main effect of the time variable from 2006 to 2016. We evaluated the interaction terms of the time variable and these key covariates to determine differential changes by demographics and SES status. The backward elimination procedure was used to identify significant interaction terms by removing terms from the multivariate logistic regression

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model with a threshold of p-value greater or equal to 0.05. Statistical significance was determined by p-value < 0.05.

Patient and Public Involvement

No patient involved.

RESULTS

The demographics of 102,953 married couples from 2006 and 2016 NFHS waves are provided in Table 1. The average age for wives was 31.3 years for 2006 and 32.8 years for 2016. The average age for husbands was 36.7 years for 2006 and 37.7 for 2016. Less than half of wives were reported to be employed, whereas more than 90% of the husbands were employed in both waves.

Table 2 summarizes the prevalence of past-year STI and any STI symptoms as individually reported by married couples from 2006 and 2016 NFHS waves. Married women reported a significantly greater increase in self-report STI from 2006 to 2016 when compared to married men. In 2016, 2.5% of married women reported having had an STI in the past year, which significantly increased from 1.6% in 2006 ($p<0.001$). The national prevalence of past-year STI among married men increased significantly from 0.5% in 2006 to 1.1% in 2016 ($p<0.001$). The prevalence of STI among married couples has significantly increased from 2.06% in 2006 to 3.55% in 2016 ($p<0.001$). Figure 2 shows an increase in prevalence across self-report STI and other STI related symptoms from 2006 to 2016 among married couples in India.

For STI symptoms (Table 2), including genital sore and discharge, there was a significantly higher prevalence among husbands in 2016 compared to 2006. For married men, 6.2% reported having had any STI symptoms in 2016 compared to 3.9% in 2006, a substantial increase over the period ($p<0.001$). Married women also reported a significantly higher prevalence of an STI symptom for genital sores from 2.3% in 2006 to 3.1% in 2016 ($p<0.001$). Overall, the prevalence of any STI and symptoms in the past year experienced by married couples has significantly increased from 14.7% in 2006 to 17.4% in 2016 ($p<0.001$).

Table 3 provides a summary of bivariate and multiple logistic regressions with the couple's STI status only as the primary outcome variable. In both bivariate and adjusted models, married couples in 2016 were approximately 70% more likely to report having STI in the past year (aOR=1.61, $p<0.001$, 95% CI=1.40, 1.85). Mutually adjusting for the individual- and couple-level socio-demographic and SES factors, husband's education in college or above (aOR=1.31, $p<0.05$, 95% CI=1.03, 1.68), secondary (aOR=1.33, $p<0.01$, 95% CI=1.09, 1.62), and primary levels (aOR=1.20, $p<0.05$, 95% CI=1.01, 1.43) were significantly positively associated with the couple's STI status, relative to those who were illiterate. Although those with higher secondary education were not significantly different from those who were illiterate (aOR=1.04, 95% CI=0.82, 1.31). In both bivariate and multivariate analyses, husband's caste status as a scheduled caste (aOR=1.50, $p<0.05$, 95% CI=1.04, 2.15) was significantly positively associated with the couple's STI status. Other caste categorizations, such as scheduled tribe and other backward class, were not significantly associated with couple's STI status. In both models, family wealth at highest quintile (aOR=1.33, $p<0.05$, 95% CI=1.05, 1.69) was found to be significantly associated

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with couple's STI—while other lower quintiles were not significant. Meanwhile, age, religion, employment, and residence were not significantly associated with STI status in couples when adjusted with other factors.

Table 4 demonstrates the time trend by socio-economic status (SES) interactions in moderating the risk of self-reporting STI in married couples. This list of SES variables includes an individual's education and employment status, and the couple's family wealth index, and residence. The first column in Table 4 provides a summary of adjusted multivariate relationships with all trends by SES interaction terms simultaneously in predicting self-reporting STI, controlling for the main effects of age, religion, caste, and all SES variables. For the second column in Table 4 as the final model, we implemented backward elimination procedures to retain trend by SES interaction terms that were statistically significant, adjusting for the main effects of age, religion, caste, and all SES variables. The husband's employment was positively associated with the uptrend of the married couple's report of past-year STI from 2006 to 2016 (aOR=2.02, $p<0.05$, 95% CI=1.13, 3.60). Couples who were in the highest (aOR=2.60, $p<0.001$, 95% CI=1.72, 3.92), fourth quintile (aOR=2.52, $p<0.001$, 95% CI=1.67, 3.80), and middle quintile (aOR=1.69, $p<0.01$, 95% CI=1.14, 2.52) of family wealth were significantly more likely to experience an increase from 2006 to 2016 in reporting past-year STI compared to those in the lowest quintile of family wealth.

We also examined the relationship between the socio-demographic factors and treatment or seeking advice for STI or symptoms in the past 12 months. As shown in Table 5, using the multivariate analysis, we calculated the adjusted odds ratios for married individuals' likelihood of receiving treatment or seeking advice after accounting for all the demographics and socio-economic status. For the multivariate-adjusted model, husbands with recent STI or symptoms in 2016 were significantly less likely (aOR=0.50, $p<0.001$, 95% CI=0.40, 0.62) to receive treatment or advice compared to those in 2006. Husband's likelihood of seeking treatment or advice for STI and symptoms were positively associated with wife's scheduled caste status (aOR=1.85, $p<0.01$, 95% CI=1.20, 2.84). However, husband's scheduled caste status was associated with less likelihood of receiving treatment or advice (aOR=0.60, $p<0.05$, 95% CI=0.39, 0.91). Husbands with family wealth in the second quintile (aOR= 1.35, $p<0.05$, 95% CI=1.05, 1.73) compared to those in the lowest quintile were more likely to receive treatment or seek advice. Other factors, such as age, education level, employment, religion, and residence, were not significantly associated with the husband's treatment or seeking advice for STI and symptoms in this adjusted multivariate model.

For the next adjusted model, wives in 2016 had an adjusted odds ratio of 0.88 ($p<0.05$, 95% CI=0.78, 0.99) that was significantly less likely to receive treatment or seek advice for STI and symptoms when compared to 2006. Wives were more likely to receive treatment or seek advice when they had secondary (aOR=1.37, $p<0.01$, 95% CI=1.13, 1.66), primary (aOR=1.35, $p<0.001$, 95% CI=1.17, 1.55) education level compared to those who were illiterate. Wives whose husband had higher secondary (aOR=1.29, $p<0.05$, 95% CI=1.02, 1.63), secondary (aOR=1.23, $p<0.05$, 95% CI=1.01, 1.48), and primary (aOR=1.24, $p<0.05$, 95% CI=1.05, 1.45) education level were also more likely to receive treatment or seek advice. For family wealth, wives in the highest (aOR=1.91, $p<0.001$, 95% CI=1.51, 2.41), fourth (aOR=1.65, $p<0.001$, 95% CI=1.35, 2.02), and middle (aOR=1.31, $p<0.01$, 95% CI=1.09, 1.59) quintiles were significantly

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more likely to receive treatment or seek advice compared to those in lowest family wealth quintile when adjusted with other socio-demographic variables. Other factors, such as age, religion, and residence, were not significantly associated with the wife's treatment or seeking advice for STI and symptoms in this adjusted multivariate model.

DISCUSSION

The results from the analyses from two waves of NFHS identify a significant increase in self-reporting STI prevalence among both married men and women over the past decade in India. In 2016, 2.5% of married women reported having had an STI in the past year, which significantly increased from 1.6% in 2006. Adjusted results showed that the uptrend of couples' self-reporting STI was more significant among those whose husbands are currently employed, and those families in middle or higher wealth quintiles. Alarmingly, among couples who reported STI or symptoms, both husband and wife were less likely to seek advice or treatment in 2016 than in 2006.

Our study utilizes the two latest datasets from a large nationally representative health survey to assess the relationship between STI and various socio-demographic factors in India. To the best of our knowledge, this is the first study that describes the changes of STI prevalence among married couples in India from 2006 to 2016 and assesses whether the changes vary by socio-demographic and economic conditions. Our findings are different from the cross-sectional results of a past similar study based on a single wave of India national survey data of 1998, that showed that the rural women, Muslim, and illiterate women had a higher STI prevalence.[17] With the newer datasets from 2006 and 2016, our analysis revealed a new finding that married couples with currently employed husbands and with middle or higher wealth are associated with greater odds of self-report of STI. With rising disposable income due to rapid economic development in India in the past decades,[29] it is possible that the availability of disposable economic resources may have increased the likelihood of risky sexual behaviors. There is evidence that in some epidemiological studies of HIV, wealthier individuals may engage in risky sexual behaviors that increase their vulnerability to infections.[30,31] Other work in Uganda has found that the middle wealth quintile and disposable income posed higher risk for STI.[32] According to our findings, wives with middle or higher household wealth were more likely to seek advice or treatment for STI compared to those with lower wealth. A combination of these two factors may have contributed to the higher rates of self-report STIs among wealthier group. The imbalance of wealth among husband and wife may contribute to a shift of family dynamics that may further affect sexual health and broadly intimate partner relationship.

Since this study used only a limited number of socio-demographic factors in the adjusted multivariate analysis, the contextual background behind these socio-economic indicators included in this study may need to be further examined. Further study is warranted to ascertain associations between couples' STI and socio-demographics after accounting for another individual, family, and state covariates. Also, the decreased prevalence of seeking advice or treatment for STI from 2006 (47.8%) to 2016 (31.9%) suggests that efforts are needed to continue improving sexual healthcare utilization in India. Studies in India suggest that stigma, geography, and discrimination are often barriers among high-risk groups to seek health care and treatment for STI.[33-35]

There are several limitations to our study. Although the NFHS followed a rigorous and established data collection methodology, there may be self-report bias. According to the interviewer's manual, the survey interviewers administering the NFHS are culturally trained to build rapport, establish safe and private settings, and assure confidentiality of the respondents.[36] Despite these efforts, survey respondents may have still misreported their STI status due to the sensitive nature, cultural stigma, and social undesirability associated with STI. Compared to clinical data gathered from STI laboratory tests, self-reported STI status may have been underreported or misreported. There is also a possibility of recall bias due to a longer time interval for the period of the past 12 months for STI incidence. Despite this concern, it is worth noting the large scope of the epidemiological data as it can be useful as compared to smaller clinical samples.

Although our analyses use the latest available datasets of two different time points, it should be noted that there is a limitation in assessing change in prevalence between only two-time points. Due to the administration interval of DHS surveys, there is a ten-year gap between the two survey waves. The gap between these two survey periods may introduce additional source of bias that can affect the association. The cross-sectional design is limited to causal inference. Because the current investigation focuses on demographic and socio-economic conditions, there may be additional residual confounding due to unobserved factors.

Evaluating the relationship of socio-demographic determinants and STI rates among married couples can be valuable for programmatic and policy decisions for community-based clinical care to improve sexual health outcomes for married individuals. The prevention and intervention models for sexual health in communities in India should consider the multitude of social factors that may put certain groups of individuals at greater risk for STI infections than others.

Contributors

J. Choi performed the analyses, interpreted the results, and led the writing. Z. Xuan conceived of the study and supervised all aspects of the study. D. Bahl and M. Arora contributed significantly to the interpretation of findings and review of the article. All authors reviewed the manuscript and approve of its contents.

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Competing interests

None declared.

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Table 1. Background characteristics of married couples, India National Family Health Survey, 2006 - 2016.

	2006 (N=39,257)		**2016** (N=63,696)	
	%	SE	%	SE
Wife age (Mean)	31.31	0.06	32.76	0.05
Wife education				
- College or above	6.07	0.22	10.28	0.31
- Higher secondary	5.09	0.16	9.07	0.19
- Secondary	13	0.27	18.07	0.28
- Primary	28.9	0.38	31.26	0.31
- Illiterate	46.96	0.51	31.31	0.32
Wife employment	37.99	0.5	25.46	0.33
Wife religion				
- Hindu	82.5	0.6	82.03	0.41
- Muslim	11.98	0.58	12.48	0.37
- Christian	2.37	0.15	2.39	0.11
- Other	3.15	0.19	3.1	0.16
Wife caste/tribe				
- Scheduled caste	19.55	0.53	20.55	0.4
- Scheduled tribe	9.36	0.45	10.01	0.25
- Other backward class	39.97	0.63	45.63	0.45
- Others (none of them)	31.13	0.6	23.82	0.41
Husband age (Mean)	36.68	0.06	37.7	0.05
Husband education				
- College or above	11.27	0.31	14.01	0.33
- Higher secondary	8.44	0.22	11.55	0.24
- Secondary	18.93	0.3	22.58	0.3
- Primary	36.65	0.42	34.19	0.33
- Illiterate	24.7	0.44	17.67	0.25
Husband employment	96.65	0.16	92.01	0.19
Husband religion				
- Hindu	82.58	0.6	82.25	0.41
- Muslim	12.01	0.58	12.55	0.38
- Christian	2.25	0.14	2.23	0.12
- Other	3.16	0.19	2.97	0.15
Husband caste/tribe				
- Scheduled caste	19.69	0.53	20.80	0.42
- Scheduled tribe	9.38	0.44	9.85	0.26
- Other backward class	40.62	0.64	45.53	0.46
- Others (none of them)	30.32	0.60	23.82	0.42
Family wealth				
- Highest	21.48	0.47	22.51	0.42
- Fourth	20.31	0.39	21.86	0.33
- Middle	20.24	0.38	21.06	0.28
- Second	19.52	0.36	18.78	0.26
- Lowest	18.45	0.46	15.78	0.24
Family residence				
- Urban	32.54	0.41	36.01	0.37
- Rural	67.46	0.41	63.99	0.37

SE= Standard Error

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Table 2. Prevalence of past-year STI and STI symptoms by married couples' self-reports, India National Family Health Survey, 2006 - 2016.

		STI % (SE)	**Any STI symptoms** % (SE)	**- Genital Sore** % (SE)	**- Genital Discharge** % (SE)	**Any STI and symptoms** % (SE)
2006	Husband	0.50 (0.06)	3.89 (0.19)	2.14 (0.13)	2.36 (0.14)	4.07 (0.19)
	Wife	1.58 (0.11)	11.02 (0.28)	2.27 (0.12)	10.10 (0.26)	11.32 (0.28)
	Couple	2.06 (0.12)	14.22 (0.32)	4.29 (0.17)	12.11 (0.29)	14.72 (0.32)
2016	Husband	1.07 (0.06)	6.22 (0.22)	2.56 (0.11)	4.62 (0.20)	6.75 (0.22)
	Wife	2.52 (0.11)	10.63 (0.22)	3.14 (0.12)	9.59 (0.21)	11.57 (0.23)
	Couple	3.55 (0.13)	16.05 (0.30)	5.58 (0.16)	13.65 (0.28)	17.40 (0.30)
		STI Chi-square (p-value)	**Any STI symptoms** Chi-square (p-value)	**- Genital Sore** Chi-square (p-value)	**- Genital Discharge** Chi-square (p-value)	**Any STI and symptoms** Chi-square (p-value)
2006 vs. 2016	Husband	38.67***	61.22***	5.59*	85.35***	78.23***
	Wife	32.78***	1.23	24.68***	2.26	0.45
	Couple	63.93***	17.24***	28.32***	14.36***	36.37***

*p<0.05
**p<0.01
***p<0.001
SE= Standard Error

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Table 3. Associations of married couples' current STI status with individual's demographics and socio-economic status.

	n	Couple's STI, %	Couple's STI (Bivariate)		Couple's STI (Multivariate)	
			OR	(95% CI)	Adjusted OR	(95% CI)
Year 2016	63,612	3.55	1.75***	(1.52, 2.01)	1.61***	(1.40, 1.85)
2006	39,078	2.06	Ref.		Ref.	
Wife's age	102,690	2.96	1.00	(0.99, 1.01)	1.01	(0.99, 1.02)
Wife's education						
- College or above	9,178	4.06	1.56***	(1.22, 2.00)	1.17	(0.87, 1.57)
- Higher secondary	8,304	3.72	1.43***	(1.17, 1.74)	1.13	(0.88, 1.44)
- Secondary	17,265	3.11	1.19*	(1.01, 1.40)	0.97	(0.80, 1.18)
- Primary	31,818	2.76	1.05	(0.92, 1.20)	0.91	(0.79, 1.06)
- Illiterate	36,124	2.64	Ref.		Ref.	
Wife's employment	30,163	2.85	0.95	(0.84, 1.07)	1.03	(0.91, 1.17)
Wife's religion						
- Hindu	77,388	2.88	0.92	(0.70, 1.22)	0.97	(0.60, 1.58)
- Muslim	12,905	3.51	1.13	(0.83, 1.54)	1.05	(0.55, 2.00)
- Christian	7,613	2.71	0.87	(0.56, 1.34)	0.79	(0.33, 1.86)
- Other	4,737	3.12	Ref.		Ref.	
Wife caste/tribe						
- Scheduled caste	18,090	3.03	1.13	(0.95, 1.34)	0.93	(0.65, 1.35)
- Scheduled tribe	16,494	2.69	1.00	(0.79, 1.27)	1.06	(0.67, 1.67)
- Other backward class	38,957	3.08	1.15	(0.98, 1.34)	1.07	(0.84, 1.36)
- Others (none of them)	25,306	2.70	Ref.		Ref.	
Husband's age	102,690	2.96	1.00	(0.99, 1.00)	0.99	(0.98, 1.01)
Husband's education						
- College or above	13,860	3.78	1.67***	(1.34, 2.08)	1.31*	(1.03, 1.68)
- Higher secondary	11,145	2.78	1.21	(1.00, 1.47)	1.04	(0.82, 1.31)
- Secondary	22,459	3.34	1.47***	(1.23, 1.75)	1.33**	(1.09, 1.62)
- Primary	36,050	2.85	1.25**	(1.07, 1.46)	1.20*	(1.01, 1.43)
- Illiterate	19,163	2.30	Ref.		Ref.	
Husband's employment	95,874	2.94	0.90	(0.72, 1.14)	0.97	(0.76, 1.24)
Husband's religion						
- Hindu	77,594	2.87	0.92	(0.69, 1.23)	1.01	(0.61, 1.66)
- Muslim	12,901	3.53	1.14	(0.83, 1.57)	1.31	(0.68, 2.54)
- Christian	7,431	2.72	0.87	(0.55, 1.37)	0.93	(0.38, 2.25)
- Other	4,756	3.12	Ref.		Ref.	
Husband caste/tribe						
- Scheduled caste	18,160	3.21	1.24*	(1.05, 1.47)	1.50*	(1.04, 2.15)
- Scheduled tribe	16,489	2.62	1.01	(0.81, 1.25)	1.17	(0.77, 1.77)
- Other backward class	39,227	3.08	1.19*	(1.02, 1.38)	1.17	(0.92, 1.47)
- Others (none of them)	24,517	2.61	Ref.		Ref.	
Family wealth						
- Highest	23,546	3.51	1.42***	(1.17, 1.73)	1.33*	(1.05, 1.69)
- Fourth	22,358	3.05	1.23*	(1.02, 1.48)	1.15	(0.93, 1.43)
- Middle	21,435	2.89	1.17	(0.97, 1.40)	1.10	(0.90, 1.32)
- Second	19,451	2.70	1.09	(0.91, 1.30)	1.02	(0.85, 1.23)
- Lowest	15,900	2.49	Ref.		Ref.	
Family residence						

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- Urban	37,261	3.21	1.15	(1.00, 1.31)	0.94	(0.81, 1.10)
- Rural	65,429	2.82	Ref.		Ref.	

*p<0.05
**p<0.01
***p<0.001
OR = Odds Ratio
95% CI = 95% Confidence Intervals
Ref. = Reference groups for odds ratios

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Table 4. Interaction terms between year trend and individual's demographics and socio-economic status in predicting married couples' current STI status, 2006 and 2016.

Interaction terms between year and each of the following predictors	Couple's STI[b] Adjusted OR (95% CI)		Couple's STI[d] Adjusted OR (95% CI)	
Wife's education				
- College or above	1.29	(0.68, 2.46)		
- Higher secondary	1.12	(0.63, 1.96)		
- Secondary	1.82*	(1.14, 2.88)		
- Primary	1.36	(0.99, 1.88)		
- Illiterate	Ref.			
Wife's employment	1.18	(0.90, 1.56)		
Husband's education				
- College or above	0.95	(0.54, 1.70)		
- Higher secondary	0.87	(0.51, 1.47)		
- Secondary	1.08	(0.70, 1.66)		
- Primary	1.06	(0.74, 1.52)		
- Illiterate	Ref.			
Husband's employment	1.97*	(1.10, 3.52)	2.02*	(1.13, 3.60)
Family wealth				
- Highest	2.08**	(1.21, 3.57)	2.60***	(1.72, 3.92)
- Fourth	2.07**	(1.28, 3.34)	2.52***	(1.67, 3.80)
- Middle	1.49	(0.99, 2.25)	1.69**	(1.14, 2.52)
- Second	1.27	(0.86, 1.88)	1.36	(0.93, 1.99)
- Lowest	Ref.		Ref.	
Family residence				
- Urban	1.12	(0.79, 1.59)		
- Rural	Ref.			

*p<0.05
**p<0.01
***p<0.001
OR = Odds Ratio
95% CI = 95% Confidence Intervals
Ref. = Reference groups for odds ratios

[a]Adjusted multivariate analysis for all predictors included in the table, including age, religion, and caste

[b]Multivariate analysis for SES variables (employment, family wealth) as predictors and adjusted to all predictors included in the table, including age, religion, and caste

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Table 5. Associations of likelihood of married couples, who reported STI or symptoms, seeking advice or treatment when they had STI/discharge/sore/ulcer and individual's demographics and socio-economic status, 2006 and 2016.

	Husband's treatment or seeking advice for STI and symptoms (Multivariate) Adjusted OR (95% CI)		**Wife's treatment or seeking advice for STI and symptoms (Multivariate)** Adjusted OR (95% CI)	
Year 2016	0.50***	(0.40, 0.62)	0.88*	(0.78, 0.99)
2006	Ref.		Ref.	
Wife's age	1.02	(0.99, 1.04)	1.00	(0.99, 1.02)
Wife's education				
- College or above	1.33	(0.86, 2.06)	1.17	(0.86, 1.59)
- Higher secondary	1.31	(0.90, 1.92)	1.25	(0.98, 1.61)
- Secondary	1.09	(0.81, 1.47)	1.37**	(1.13, 1.66)
- Primary	0.92	(0.74, 1.14)	1.35***	(1.17, 1.55)
- Illiterate	Ref.		Ref.	
Wife's employment	0.99	(0.82, 1.19)	1.12	(1.00, 1.27)
Wife's religion				
- Hindu	1.14	(0.52, 2.53)	0.92	(0.54, 1.58)
- Muslim	1.50	(0.50, 4.50)	1.64	(0.79, 3.43)
- Christian	0.42	(0.15, 1.14)	1.18	(0.59, 2.38)
- Other	Ref.		Ref.	
Wife caste/tribe				
- Scheduled caste	1.85**	(1.20, 2.84)	0.77	(0.54, 1.09)
- Scheduled tribe	1.51	(0.78, 2.92)	0.85	(0.54, 1.35)
- Other backward class	1.12	(0.79, 1.58)	0.90	(0.71, 1.16)
- Others (none of them)	Ref.		Ref.	
Husband's age	0.99	(0.97, 1.01)	1.01	(0.99, 1.02)
Husband's education				
- College or above	1.00	(0.68, 1.47)	1.28	(1.00, 1.65)
- Higher secondary	0.87	(0.60, 1.27)	1.29*	(1.02, 1.63)
- Secondary	1.04	(0.77, 1.40)	1.23*	(1.01, 1.48)
- Primary	1.00	(0.78, 1.27)	1.24*	(1.05, 1.45)
- Illiterate	Ref.		Ref.	
Husband's employment	1.04	(0.74, 1.34)	1.09	(0.87, 1.35)
Husband's religion				
- Hindu	0.81	(0.37, 1.79)	0.75	(0.43, 1.30)
- Muslim	1.12	(0.38, 3.31)	0.49	(0.23, 1.05)
- Christian	1.38	(0.49, 3.86)	0.60	(0.29, 1.25)
- Other	Ref.		Ref.	
Husband caste/tribe				
- Scheduled caste	0.60*	(0.39, 0.91)	1.24	(0.87, 1.76)
- Scheduled tribe	0.69	(0.38, 1.24)	0.97	(0.61, 1.54)
- Other backward class	0.77	(0.54, 1.11)	1.05	(0.81, 1.36)
- Others (none of them)	Ref.		Ref.	
Family wealth				
- Highest	1.22	(0.86, 1.74)	1.91***	(1.51, 2.41)
- Fourth	1.18	(0.86, 1.74)	1.65***	(1.35, 2.02)
- Middle	1.20	(0.90, 1.60)	1.31**	(1.09, 1.59)
- Second	1.35*	(1.05, 1.73)	1.15	(0.95, 1.39)

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- Lowest	Ref.		Ref.	
Family residence				
- Urban	1.15	(0.92, 1.44)	1.07	(0.93, 1.22)
- Rural	Ref.		Ref.	

*p<0.05
**p<0.01
***p<0.001
OR adjusted for all variables included in the table
OR = Odds Ratio
95% CI = 95% Confidence Intervals
Ref. = Reference groups for odds ratios

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Figure 1. Flow diagram of final sample sizes of married couples, India National Family Health Survey, 2006 - 2016.

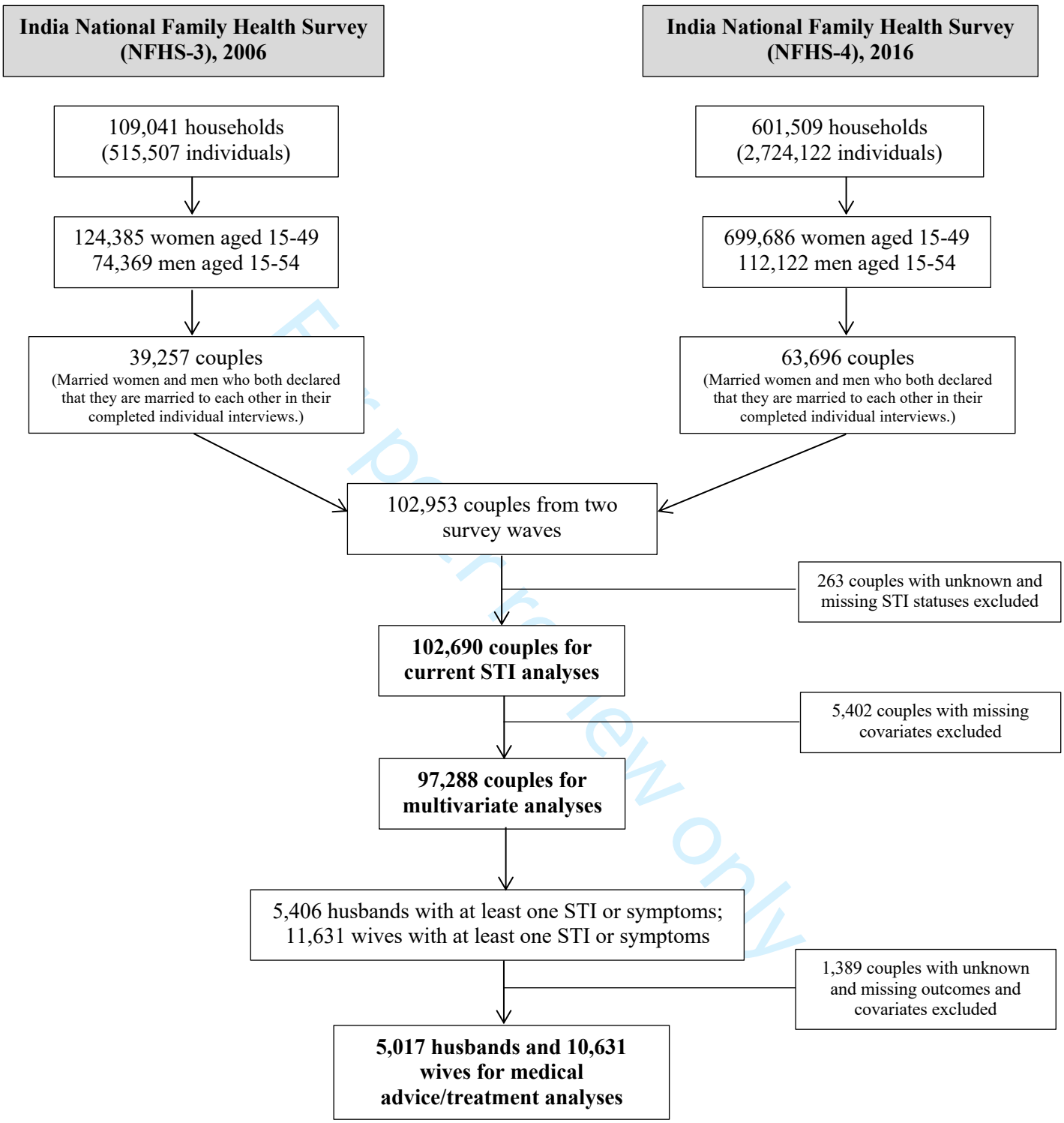

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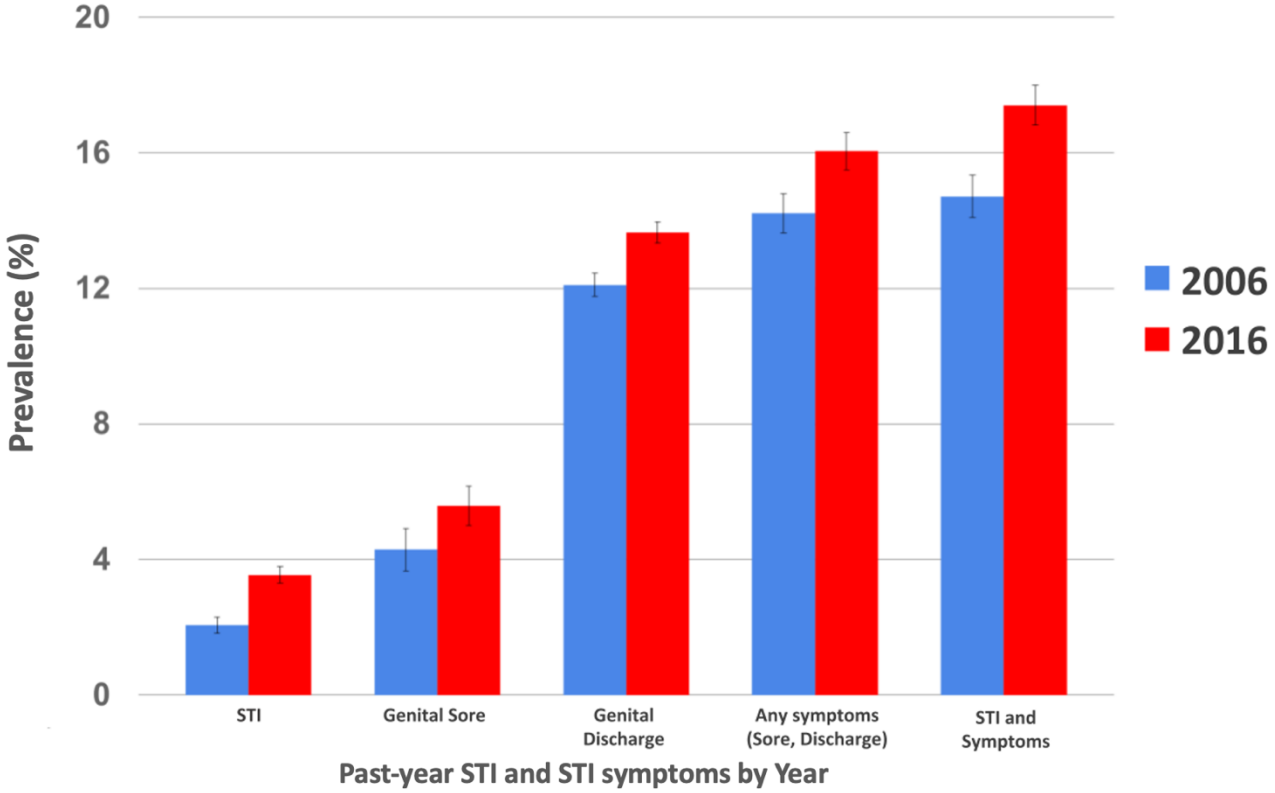
Figure 2. Prevalence (%) of married couple's recent STI and STI symptoms by years, 2006 and 2016.



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STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page and Line No. from the Manuscript
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Pg 1, line 1-3
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Pg 1, line 14-34
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Pg 2, line 10-29
Objectives	3	State specific objectives, including any prespecified hypotheses	Pg 2, line 31-37
Methods			
Study design	4	Present key elements of study design early in the paper	Pg 3, line 35-46
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Pg 2, line 41-46; pg 3, line 1-5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	Pg 3, line 2-5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Pg 3, line 7-29
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Pg 2, line 41-44
Bias	9	Describe any efforts to address potential sources of bias	Pg 3, line 10-19
Study size	10	Explain how the study size was arrived at	Pg 3, line 2-5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Pg 3, line 7-33
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Pg 3, line 36-46
		(*b*) Describe any methods used to examine subgroups and interactions	Pg 3, line 36-46
		(*c*) Explain how missing data were addressed	Pg 3, line 2-5
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	Pg 3, line 29-31
		(*e*) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Pg 4, line 9; Figure 1
		(b) Give reasons for non-participation at each stage	Figure 1
		(c) Consider use of a flow diagram	Figure 1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Pg 4, line 9-13; Figure 1

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		(b) Indicate number of participants with missing data for each variable of interest	Figure 1
Outcome data	15*	Report numbers of outcome events or summary measures	Pg 4, line 15-31; Table 2
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Pg 4, line 33-46; Pg 5, 1-19; Table 3 and 4
		(*b*) Report category boundaries when continuous variables were categorized	N/A
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Pg 5, line 21-46; Pg 6, line 1-4
Discussion			
Key results	18	Summarise key results with reference to study objectives	Pg 6, line 8-15
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Pg 7, line 2-20
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Pg 6, line 17-46
Generalisability	21	Discuss the generalisability (external validity) of the study results	Pg 6, line 38-46
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Pg 7, line 37-40

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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Changes in Self-Reported Sexually Transmitted Infections and Symptoms among Married Couples in India from 2006 to 2016: A Repeated Cross-sectional Multivariate Analysis from Nationally Representative Data

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Changes in Self-Reported Sexually Transmitted Infections and Symptoms among Married Couples in India from 2006 to 2016: A Repeated Cross-sectional Multivariate Analysis from Nationally Representative Data

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Objective: To assess the changes in prevalence of past-year self-reported Sexually Transmitted Infections and its symptoms among married couples between 2006 and 2016 in India, overall, and by socio-economic status.
Design: This cross-sectional study utilizes the two most recent waves (2005-2006 vs. 2015-2016) of nationally representative health surveys in India. We examined the changes of self-reported STI and symptoms among married couples aged 15-54 by overall and by socio-economic status. Adjusted logistic regression was used to assess the changes, accounting for covariates and the complex survey design.
Setting: Cross-sectional, nationally representative population-based survey in 2005-2006 and 2015-2016 from National Family Health Survey data from Demographic and Health Survey.
Participants: 39,257 married couples aged 15-49 years for the 2005-2006 survey wave and 63,696 married couples aged 15-49 years for the 2015-2016 wave.
Outcome measure: Self-reported STI was used as a primary outcome measure.
Results: In 2016, 2.5% of married women reported having had an STI in the past year, a significant increase from 1.6% in 2006 ($p<0.001$). The past-year self-reported STI prevalence among married men significantly increased from 0.5% in 2006 to 1.1% in 2016 ($p<0.001$). Adjusted results showed that the uptrend of couples' self-reported STI was more significant among those whose husbands are currently employed and those families in middle or higher wealth quintiles. Alarmingly, among couples who reported STI or symptoms, they were less likely to seek advice or treatment in 2016 as compared to 2006 (aOR=0.50, $p<0.001$, 95% CI=0.40, 0.61).
Conclusion: The study identifies a substantial increase in self-reported STI prevalence with a notable treatment seeking gap among married couples in India over the past decade.

Article Summary

Strengths and Limitations of this study

- Utilizes a large nationally representative health survey to assess the relationship between self-reported STI and various socio-demographic factors in India
- Examines the change of self-reported STI prevalence among married couples with the two most recent data available from 2006 to 2016
- Cross-sectional data limits causal inference
- Survey data may suffer from self-report bias

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INTRODUCTION

The epidemic of sexually transmitted infections (STI) is a growing global concern.[1] A report from the World Health Organization (WHO) estimates 376 million newly diagnosed STI cases each year.[2] STIs come in a bacterial or viral form and can cause symptoms that affect morbidity, mortality, mental health, psychosocial well-being, family relation, and the overall quality of life.[3–5] Negative consequences of STI and symptoms present a significant public health challenge, especially in low- to middle-income countries with limited health system infrastructure.[1,3,6]

Socio-demographic factors and economic conditions are associated with the prevalence of STI to a varying degree. Certain demographic factors are more vulnerable to STI, such as in education, wealth, rurality, and other socio-demographic and economic conditions in developing countries.[7–13] Among these countries, India is currently undergoing a profound epidemiologic transition amid rapid economic development. Preliminary evidence from regional studies suggests increased STI prevalence in certain vulnerable social groups, like those below primary education level, illiteracy, and unemployment.[14–16] Another study, which used the data from the 1998 wave of the National Family Health Survey (NFHS) and two waves of 1998 and 2002 waves of the District Level Household Survey – Reproductive and Child Health (DLHS-RCH), reported that rural women, Muslim, illiterate, and whose marriage occurred at a very young age of less than 18 years old had a higher STI prevalence.[17]

To date, there is a gap in the literature that examines the trends of STI prevalence in recent years in India, particularly among married couples over time. The available literature on STI trends in India tend to focus on high-risk groups, such as female sex workers and men who have sex with men.[18–22] Existing literature that assesses STI prevalence among married couples in India only reports on one timepoint without time-trend epidemiological analyses.[23–25] Most of the aforementioned studies have been restricted to specific regions of India; thus, the findings are not generalizable to describe the national trend of STI and not adequate to inform whether there have been differential impacts of STI trend on specific subpopulations.

This study analyzes two recent waves of India's NFHS spanning over a decade to assess self-reported STI prevalence among married couples and examine whether there are differential trends based on the married couples' socio-demographic factors, such as education, religion, rurality, and wealth. This study provides further evidence of differential patterns of self-reported STI across various demographic and socio-economic conditions through nationally representative samples in the last decade, where there has been profound economic development and epidemiologic transition in India.

METHODS

India NFHS is part of the Indian Demographic and Health Survey (DHS), a nationally representative household-based health surveillance system. This study used the nationally representative sample of married couples aged 15-54 from two different waves in 2005-06 NFHS-3 (N=39,257) and 2015-16 NFHS-4 (N=63,696). Informed consent for participation in the

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survey was obtained for all respondents prior to the interview. Interviewers were trained to interview the respondent alone to establish privacy—without other eligible respondents in the household. The reported rates of married couples who do not cohabitate at the time of the survey were less than 1% (female, 2006: 0.62%; female, 2016: 0.37%; male, 2006: 0.26%; male, 2016: 0.14%). The overall response rates were more than 95% for both waves of the survey.[26,27] Both NFHS-3 and NFHS-4 conducted household surveys in states and union territories of India. Both survey samples were systematically stratified in multiple stages using the primary sampling units based on the size of rural villages and urban census blocks, and the randomly selected households within each cluster were chosen for interviews. A detailed sample design is described in the NFHS report.[26,27] As shown in Figure 1, the datasets had 39,257 and 63,696 matched couples in a household for NFHS-3, 2006 and NFHS-4, 2016 survey wave, respectively; when both waves were combined, there were 102,953 couples identified. Then, a sample of 102,690 couples from two survey waves was analyzed for self-reported STI analyses after excluding couples with unknown and missing self-reported STI status. For the multivariate analyses, a sample of 97,288 couples was analyzed after excluding couples with missing covariates. After accounting for unknown and missing variables, among those with at least one self-reported STI or symptoms, we identified 5,017 husbands and 10,631 wives to analyze the outcomes for individuals seeking treatment or advice for STI or its symptoms.

In both NFHS waves, respondents were asked *if they have ever had sex* and were asked whether they *heard about other sexually transmitted infections.* When they responded yes to those two aforementioned questions, then they were asked: *During the last 12 months, have you had a disease which you got through sexual contact?* This variable was coded as a primary outcome of self-reported STI for our study. Regardless of whether they have heard about STI, the women respondents were asked to identify STI symptoms through these two questions: *(1) During the last 12 months, have you had a bad smelling abnormal genital discharge? (2) During the last 12 months, have you had a genital sore or ulcer?* For men, they were asked: *(1) During the last 12 months, have you had an abnormal discharge from your penis? (2) During the last 12 months, have you had a sore or ulcer on or near your penis?* These two separate STI symptoms variables were combined and coded as a single dichotomous variable to indicate any STI symptom of a bad-smelling, abnormal discharge from the vagina/penis, a genital sore, or a genital ulcer. The survey did not specify the diseases of STI diagnoses. For the analyses, the self-reported STI/STI symptom outcomes were categorized as if the respondents had reported STI and/or STI symptoms in the past year. Because STI among any partner in marriage affects the couple's sexual health and family relationship, we followed the prior method[28] and grouped the self-reported STI prevalence of at least one of the married couples as a single dichotomous variable to code as the primary self-reported STI outcome of a couple. Instead of individual prevalence, we used the couple STI prevalence as the primary outcome because the self-reported STI prevalence trend for husband and wife across two waves remained similar in both waves. Among those who reported any STI or symptoms, the survey asked whether they sought advice or treatment when they had STI/discharge/sore/ulcer in the past year. This paper also used married individuals' treatment or seeking advice for STI or its symptoms as a separate outcome. We used self-reported STI status as a primary outcome in our multivariate analysis.

The year variable was coded as follows for each wave: the survey for 2016 was coded as 1, and 0 for 2006. We used covariates that wife and husband individually reported, such as age, education

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(college or above, higher secondary, secondary, primary, illiterate), current employment status, religion (Hindu, Muslim, Christian, and other), family wealth (highest, fourth, middle, second, lowest), and family residence (urban, rural). The higher secondary education group is for grades 11 and 12; the secondary education group is for grades 9 and 10; the primary education is for grades 1 to 8. The coding of these covariates was based on prior literature.[29] The caste variable was categorized as scheduled caste, scheduled tribe, other backward class, and others (none of them). The caste system in India is a traditional method of social segregation, and adverse socio-economic and health outcomes disproportionately impact those belonging to disadvantaged caste.[30] For the NFHS couple data set, we used sampling weights of men from both waves representing the respective population and its distribution at the national level. All statistical analyses were performed using the SAS software. Because we used secondary, publicly available data sources without personal identifiers, this study is exempted from Institutional Review Board's review and approval.

Prevalence of self-reported STI and symptoms were calculated for husband, wife, and couple for 2006 and 2016. Both bivariate and multivariate analyses have been conducted for this study. For this study, we used individualized socio-economic and demographic factors as the predictor variables to assess their associations with self-reported STI. We estimated associations between individual demographic and socio-economic characteristics and the couple's self-reported STI status with bivariate analysis. Multiple logistic regressions with complex survey procedures were used to model predictors of a couple's self-reported STI status. Similar approaches were also used for an individual's treatment or seeking advice for STI. To assess the changes over time, we used the year as a categorical variable using 2006 as the reference year to assess the main effect of the time variable from 2006 to 2016. We evaluated the interaction terms of the time variable and these key covariates to determine differential changes by demographics and socio-economic status (SES). The backward elimination procedure was used to identify significant interaction terms by removing terms from the multivariate logistic regression model with a threshold of p-value greater or equal to 0.05. Statistical significance was determined by a p-value < 0.05.

Patient and Public Involvement

No patients were involved.

RESULTS

The demographics of 102,953 married couples from 2006 and 2016 NFHS waves are provided in Table 1. The average age for wives was 31.3 years for 2006 and 32.8 years for 2016; the average age for husbands was 36.7 years for 2006 and 37.7 for 2016. Less than half of wives were employed, whereas more than 90% of the husbands were employed in both waves. With exception to religion, there were significant differences in socio-demographics (mean age, education, employment, caste, family wealth, and residence) of married women and men from 2006 to 2016. Compared to 2006, more women had higher education in 2016; for instance, only 6% of married women reported having a college or higher education in 2006, and for 2016, about 10% of married women reported having an education at college or above ($p<0.0001$). Wife's employment rate has significantly decreased over 10 years from 38% to 25% ($p<0.0001$). It should also be noted that similar directionality has been observed among married men: higher

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education has significantly increased, while employment has also significantly decreased from 97% in 2006 to 92% in 2016 ($p<0.0001$).

Table 2 summarizes the prevalence of past-year self-reported STI and any STI symptom as individually reported by married couples from 2006 and 2016 NFHS waves. Married women reported a significantly greater increase in self-reported STI from 2006 to 2016 when compared to married men. In 2016, 2.5% of married women reported having had an STI in the past year, which significantly increased from 1.6% in 2006 ($p<0.001$). The national prevalence of past-year self-reported STI among married men increased significantly from 0.5% in 2006 to 1.1% in 2016 ($p<0.001$). The prevalence of self-reported STI among married couples has significantly increased from 2.06% in 2006 to 3.55% in 2016 ($p<0.001$). Figure 2 shows an increase in prevalence across self-reported STI and other STI-related symptoms from 2006 to 2016 among married couples in India.

For self-reported STI symptoms (Table 2), including genital sore and discharge, there was a significantly higher prevalence among husbands in 2016 compared to 2006. For married men, 6.2% reported having had any STI symptom in 2016 compared to 3.9% in 2006, a substantial increase over the period ($p<0.001$). Married women also reported a significantly higher prevalence of self-reported STI symptoms for genital sores from 2.3% in 2006 to 3.1% in 2016 ($p<0.001$). Overall, the prevalence of any self-reported STI or any symptoms in the past year experienced by married couples has significantly increased from 14.7% in 2006 to 17.4% in 2016 ($p<0.001$).

Table 3 summarizes bivariate and multiple logistic regressions with the couple's self-reported STI status as the primary outcome variable. In the adjusted models, married couples in 2016 were approximately 60% more likely to report having STI in the past year (aOR=1.61, $p<0.001$, 95% CI=1.40, 1.85). Mutually adjusting for the individual- and couple-level socio-demographic and SES factors, husband's education in college or above (aOR=1.31, $p<0.05$, 95% CI=1.03, 1.68), secondary (aOR=1.33, $p<0.01$, 95% CI=1.09, 1.62), and primary levels (aOR=1.20, $p<0.05$, 95% CI=1.01, 1.43) were significantly positively associated with the couple's self-reported STI status, relative to those who were illiterate. Family wealth at the highest quintile (aOR=1.33, $p<0.05$, 95% CI=1.05, 1.69) was significantly associated with the couple's self-reported STI—while other lower quintiles were not significant.

Table 4 demonstrates the time trend by socio-economic status interactions in moderating the risk of self-reported STI in married couples. The husband's employment was positively associated with the uptrend of the married couple's report of past-year self-reported STI from 2006 to 2016 (aOR=2.02, $p<0.05$, 95% CI=1.13, 3.60). Couples who were in the highest (aOR=2.60, $p<0.001$, 95% CI=1.72, 3.92), fourth quintile (aOR=2.52, $p<0.001$, 95% CI=1.67, 3.80), and middle quintile (aOR=1.69, $p<0.01$, 95% CI=1.14, 2.52) of family wealth were significantly more likely to experience an increase from 2006 to 2016 in reporting past-year STI compared to those in the lowest quintile of family wealth.

We also examined the relationship between the socio-demographic factors and treatment or seeking advice for STI or symptoms in the past 12 months. Using the multivariate analysis, as shown in Table 5, husbands with recent self-reported STI or symptoms in 2016 were

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significantly less likely (aOR=0.50, p<0.001, 95% CI=0.40, 0.62) to receive treatment or advice compared to those in 2006. Husband's scheduled caste status was associated with less likelihood of receiving treatment or advice (aOR=0.60, p<0.05, 95% CI=0.39, 0.91). Husbands with family wealth in the second quintile (aOR= 1.35, p<0.05, 95% CI=1.05, 1.73) compared to those in the lowest quintile were more likely to receive treatment or seek advice.

For the next adjusted model, wives in 2016 were significantly less likely to receive treatment or seek advice for STI and symptoms when compared to 2006 (aOR=0.88, p<0.05, 95% CI=0.78, 0.99). Wives were more likely to receive treatment or seek advice when they had secondary (aOR=1.37, p<0.01, 95% CI=1.13, 1.66) and primary (aOR=1.35, p<0.001, 95% CI=1.17, 1.55) education levels compared to those who were illiterate. Wives whose husband had higher secondary (aOR=1.29, p<0.05, 95% CI=1.02, 1.63), secondary (aOR=1.23, p<0.05, 95% CI=1.01, 1.48), and primary (aOR=1.24, p<0.05, 95% CI=1.05, 1.45) education level were also more likely to receive treatment or seek advice. For family wealth, wives in the highest (aOR=1.91, p<0.001, 95% CI=1.51, 2.41), fourth (aOR=1.65, p<0.001, 95% CI=1.35, 2.02), and middle (aOR=1.31, p<0.01, 95% CI=1.09, 1.59) quintiles were significantly more likely to receive treatment or seek advice compared to those in lowest family wealth quintile when adjusted with other socio-demographic variables.

DISCUSSION

The analyses from two waves of NFHS identify a significant increase in self-reported STI prevalence among both married men and women over the past decade in India. In 2016, 2.5% of married women reported having had an STI in the past year, which significantly increased from 1.6% in 2006. Adjusted results showed that the uptrend of couples' self-reported STI was more significant among those whose husbands are currently employed and those in middle or higher wealth quintiles. Alarmingly, among couples who reported STI or symptoms, both husband and wife were less likely to seek advice or treatment in 2016 than in 2006.

Our study utilizes the two latest datasets from a large nationally representative health survey to assess the relationship between self-reported STI and various socio-demographic factors in India. To the best of our knowledge, this is the first study that describes the changes in self-reported STI prevalence among married couples in India from 2006 to 2016 and assesses whether the changes vary by socio-demographic and economic conditions. Our findings are different from the cross-sectional results of a past similar study based on a single wave of India national survey data of 1998 that showed that the rural women, Muslim, and illiterate women had a higher STI prevalence.[17] With the newer datasets from 2006 and 2016, our analysis revealed a new finding that married couples with currently employed husbands and with middle or higher wealth are associated with greater odds of self-reported STI. With rising disposable income due to rapid economic development in India in the past decades,[31] it is possible that the availability of disposable economic resources may have increased the likelihood of risky sexual behaviors. There is evidence that in some epidemiological studies of HIV, wealthier individuals may engage in risky sexual behaviors that increase their vulnerability to infections.[32,33] Other work in Uganda has found that the middle wealth quintile and disposable income posed a higher risk for STI.[34] According to our findings, wives with middle or higher household wealth were more likely to seek advice or treatment for STI compared to those with lower wealth. Combining these

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two factors may have contributed to the higher rates of self-reported STI among wealthier groups. The imbalance of wealth among husband and wife may contribute to a shift of family dynamics that may further affect sexual health and, broadly, intimate partner relationship.

Since this study used only a limited number of socio-demographic factors in the adjusted multivariate analysis, the contextual background behind these socio-economic indicators may need to be further examined. For example, statistical differences were observed when comparing socio-demographic factors from 2006 to 2016. While higher education has significantly increased over time for both married women and men, we observed a statistically significant decline in employment. An increase in education level can be attributed to India's growing higher education system. India's education system, the third-largest globally, has been growing particularly with universities, which increased 34 times from 1947 to 2014.[35] Scholars attribute the increase of education level in India to the 'Right to Education Act,' enacted in 2009 to provide free and mandatory education for children aged 6 to 18.[35,36] As for the statistically significant decline in employment for both married men and women in our study, it may be explained by the overall workforce trend in India during the last few decades. Existing literature shows that employment growth at the national level exploded between 1999 to 2005, but the net employment sharply declined the following years between 2005 to 2010; some scholars note that India saw "jobless growth" while the national economic development was underway.[37,38]

Compared to 2006, more women had higher education in 2016; for instance, only 6% of married women reported having a college or higher education in 2006, and for 2016, about 10% of married women reported having an education at college or above ($p<0.0001$). Wife's employment rate has significantly decreased over 10 years from 38% to 25% ($p<0.0001$). It should also be noted that similar directionality has been observed among married men: higher education has significantly increased, while employment has also significantly decreased from 97% in 2006 to 92% in 2016 ($p<0.0001$).

Further study is warranted to ascertain associations between couples' self-reported STI and socio-demographics after accounting for another individual, family, and state covariates. Also, the decreased prevalence of seeking advice or treatment for STI from 2006 (47.8%) to 2016 (31.9%) suggests that efforts are needed to improve sexual healthcare utilization in India. Studies in India suggest that stigma, geography, and discrimination are often barriers among high-risk groups to seek health care and treatment for STI.[39-41]

There are several limitations to our study. Although the NFHS followed a rigorous and established data collection methodology, there may be self-report bias. According to the interviewer's manual, the survey interviewers administering the NFHS are culturally trained to build rapport, establish safe and private settings, and assure the confidentiality of the respondents.[42] Despite these efforts, survey respondents may have still misreported their STI status due to the sensitive nature, cultural stigma, and social undesirability associated with STI. Compared to clinical data gathered from STI laboratory tests, self-reported STI status may have been underreported or misreported. There is also a possibility of recall bias due to a longer time interval for the past 12 months for STI incidence. Despite this concern, it is worth noting the large scope of the epidemiological data as it can be useful compared to smaller clinical samples.

Although our analyses use the latest available datasets of two different time points, there is a limitation in assessing change in prevalence between only two time points. Due to the administration interval of DHS surveys, there is a ten-year gap between the two survey waves. The gap between these two survey periods may introduce an additional source of bias that can affect the association. The cross-sectional design is limited to causal inference. Because the current investigation focuses on demographic and socio-economic conditions, additional residual confounding may be due to unobserved factors.

Evaluating the relationship of socio-demographic determinants and self-reported STI rates among married couples can be valuable for programmatic and policy decisions for community-based clinical care to improve sexual health outcomes for married individuals. The prevention and intervention models for sexual health in communities in India should consider the multitude of social factors that may put certain groups of individuals at greater risk for STI infections than others.

Contributors
J. Choi performed the analyses, interpreted the results, and led the writing. Z. Xuan conceived of the study and supervised all aspects of the study. D. Bahl and M. Arora contributed significantly to the interpretation of findings and review of the article. All authors reviewed the manuscript and approve of its contents.

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Datasets for the analyses were obtained from the Demographic and Health Survey (DHS) and are freely available online at the DHS website.

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Table 1. Background characteristics of married couples, India National Family Health Survey, 2006 - 2016.

	2006 (N=39,257) % (SE)	**2016** (N=63,696) % (SE)	**2006 vs. 2016** Chi-square (or t-statistic)	(p-value)
Wife's age (Mean)	31.31 (0.06)	32.76 (0.05)	t=18.61 (t-statistic)	<0.0001
Wife's education			981.59	<0.0001
- College or above	6.07 (0.22)	10.28 (0.31)		
- Higher secondary	5.09 (0.16)	9.07 (0.19)		
- Secondary	13.00 (0.27)	18.07 (0.28)		
- Primary	28.90 (0.38)	31.26 (0.31)		
- Illiterate	46.96 (0.51)	31.31 (0.32)		
Wife's employment	37.99 (0.50)	25.46 (0.33)	459.01	<0.0001
Wife's religion			0.91	0.8236
- Hindu	82.50 (0.60)	82.03 (0.41)		
- Muslim	11.98 (0.58)	12.48 (0.37)		
- Christian	2.37 (0.15)	2.39 (0.11)		
- Other	3.15 (0.19)	3.10 (0.16)		
Wife's caste/tribe			101.22	<0.0001
- Scheduled caste	19.55 (0.53)	20.55 (0.40)		
- Scheduled tribe	9.36 (0.45)	10.01 (0.25)		
- Other backward class	39.97 (0.63)	45.63 (0.45)		
- Others (none of them)	31.13 (0.60)	23.82 (0.41)		
Husband's age (Mean)	36.68 (0.06)	37.7 (0.05)	12.16 (t-statistic)	<0.0001
Husband's education			353.43	<0.0001
- College or above	11.27 (0.31)	14.01 (0.33)		
- Higher secondary	8.44 (0.22)	11.55 (0.24)		
- Secondary	18.93 (0.30)	22.58 (0.30)		
- Primary	36.65 (0.42)	34.19 (0.33)		
- Illiterate	24.70 (0.44)	17.67 (0.25)		
Husband's employment	96.65 (0.16)	92.01 (0.19)	301.76	<0.0001
Husband's religion			1.40	0.7049
- Hindu	82.58 (0.60)	82.25 (0.41)		
- Muslim	12.01 (0.58)	12.55 (0.38)		
- Christian	2.25 (0.14)	2.23 (0.12)		
- Other	3.16 (0.19)	2.97 (0.15)		
Husband's caste/tribe			79.41	<0.0001
- Scheduled caste	19.69 (0.53)	20.80 (0.42)		
- Scheduled tribe	9.38 (0.44)	9.85 (0.26)		
- Other backward class	40.62 (0.64)	45.53 (0.46)		
- Others (none of them)	30.32 (0.60)	23.82 (0.42)		
Family wealth			38.85	<0.0001
- Highest	21.48 (0.47)	22.51 (0.42)		
- Fourth	20.31 (0.39)	21.86 (0.33)		
- Middle	20.24 (0.38)	21.06 (0.28)		
- Second	19.52 (0.36)	18.78 (0.26)		
- Lowest	18.45 (0.46)	15.78 (0.24)		
Family residence			39.77	<0.01
- Urban	32.54 (0.41)	36.01 (0.37)		
- Rural	67.46 (0.41)	63.99 (0.37)		

SE= Standard Error

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Table 2. Prevalence of past-year self-reported STI and STI symptoms by married couples' self-reports, India National Family Health Survey, 2006 - 2016.

	2006 % (SE)	**2016** % (SE)	**2006 vs. 2016** Chi-square	(p-value)
Husband's self-reported STI	0.50 (0.06)	1.07 (0.06)	38.67***	<0.0001
Husband's any STI symptom	3.89 (0.19)	6.22 (0.22)	61.22***	<0.0001
- genital sore	2.14 (0.13)	2.56 (0.11)	5.59*	0.0180
- genital discharge	2.36 (0.14)	4.62 (0.20)	85.35***	<0.0001
Husband's any STI or symptoms	4.07 (0.19)	6.75 (0.22)	78.23***	<0.0001
Wife's self-reported STI	1.58 (0.11)	2.52 (0.11)	32.78***	<0.0001
Wife's any STI symptom	11.02 (0.28)	10.63 (0.22)	1.23	0.2665
- genital sore	2.27 (0.12)	3.14 (0.12)	24.68***	<0.0001
- genital discharge	10.10 (0.26)	9.59 (0.21)	2.26	0.1330
Wife's any STI or symptoms	11.32 (0.28)	11.57 (0.23)	0.45	0.5015
Couple's self-reported STI	2.06 (0.12)	3.55 (0.13)	63.93***	<0.0001
Couple's any STI symptom	14.22 (0.32)	16.05 (0.30)	17.24***	<0.0001
- genital sore	4.29 (0.17)	5.58 (0.16)	28.32***	<0.0001
- genital discharge	12.11 (0.29)	13.65 (0.28)	14.36***	0.0002
Couple's any STI or symptoms	14.72 (0.32)	17.40 (0.30)	36.37***	<0.0001

*p<0.05
**p<0.01
***p<0.001
SE= Standard Error

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Table 3. Associations of married couples' current self-reported STI status with individual demographics and socio-economic status.

	n	Couple's STI, %	Couple's STI (Bivariate)		Couple's STI (Multivariate)	
			OR	(95% CI)	Adjusted OR	(95% CI)
Year 2016	63,612	3.55	1.75***	(1.52, 2.01)	1.61***	(1.40, 1.85)
2006	39,078	2.06	Ref.		Ref.	
Wife's age	102,690	2.96	1.00	(0.99, 1.01)	1.01	(0.99, 1.02)
Wife's education						
- College or above	9,178	4.06	1.56***	(1.22, 2.00)	1.17	(0.87, 1.57)
- Higher secondary	8,304	3.72	1.43***	(1.17, 1.74)	1.13	(0.88, 1.44)
- Secondary	17,265	3.11	1.19*	(1.01, 1.40)	0.97	(0.80, 1.18)
- Primary	31,818	2.76	1.05	(0.92, 1.20)	0.91	(0.79, 1.06)
- Illiterate	36,124	2.64	Ref.		Ref.	
Wife's employment	30,163	2.85	0.95	(0.84, 1.07)	1.03	(0.91, 1.17)
Wife's religion						
- Hindu	77,388	2.88	0.92	(0.70, 1.22)	0.97	(0.60, 1.58)
- Muslim	12,905	3.51	1.13	(0.83, 1.54)	1.05	(0.55, 2.00)
- Christian	7,613	2.71	0.87	(0.56, 1.34)	0.79	(0.33, 1.86)
- Other	4,737	3.12	Ref.		Ref.	
Wife caste/tribe						
- Scheduled caste	18,090	3.03	1.13	(0.95, 1.34)	0.93	(0.65, 1.35)
- Scheduled tribe	16,494	2.69	1.00	(0.79, 1.27)	1.06	(0.67, 1.67)
- Other backward class	38,957	3.08	1.15	(0.98, 1.34)	1.07	(0.84, 1.36)
- Others (none of them)	25,306	2.70	Ref.		Ref.	
Husband's age	102,690	2.96	1.00	(0.99, 1.00)	0.99	(0.98, 1.01)
Husband's education						
- College or above	13,860	3.78	1.67***	(1.34, 2.08)	1.31*	(1.03, 1.68)
- Higher secondary	11,145	2.78	1.21	(1.00, 1.47)	1.04	(0.82, 1.31)
- Secondary	22,459	3.34	1.47***	(1.23, 1.75)	1.33**	(1.09, 1.62)
- Primary	36,050	2.85	1.25**	(1.07, 1.46)	1.20*	(1.01, 1.43)
- Illiterate	19,163	2.30	Ref.		Ref.	
Husband's employment	95,874	2.94	0.90	(0.72, 1.14)	0.97	(0.76, 1.24)
Husband's religion						
- Hindu	77,594	2.87	0.92	(0.69, 1.23)	1.01	(0.61, 1.66)
- Muslim	12,901	3.53	1.14	(0.83, 1.57)	1.31	(0.68, 2.54)
- Christian	7,431	2.72	0.87	(0.55, 1.37)	0.93	(0.38, 2.25)
- Other	4,756	3.12	Ref.		Ref.	
Husband caste/tribe						
- Scheduled caste	18,160	3.21	1.24*	(1.05, 1.47)	1.50*	(1.04, 2.15)
- Scheduled tribe	16,489	2.62	1.01	(0.81, 1.25)	1.17	(0.77, 1.77)
- Other backward class	39,227	3.08	1.19*	(1.02, 1.38)	1.17	(0.92, 1.47)
- Others (none of them)	24,517	2.61	Ref.		Ref.	
Family wealth						
- Highest	23,546	3.51	1.42***	(1.17, 1.73)	1.33*	(1.05, 1.69)
- Fourth	22,358	3.05	1.23*	(1.02, 1.48)	1.15	(0.93, 1.43)
- Middle	21,435	2.89	1.17	(0.97, 1.40)	1.10	(0.90, 1.32)
- Second	19,451	2.70	1.09	(0.91, 1.30)	1.02	(0.85, 1.23)
- Lowest	15,900	2.49	Ref.		Ref.	
Family residence						

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- Urban	37,261	3.21	1.15	(1.00, 1.31)	0.94	(0.81, 1.10)
- Rural	65,429	2.82	Ref.		Ref.	

*p<0.05
**p<0.01
***p<0.001
OR = Odds Ratio
95% CI = 95% Confidence Intervals
Ref. = Reference groups for odds ratios

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Table 4. Interaction terms between year trend and individual demographics and socio-economic status in predicting married couples' current self-reported STI status, 2006 and 2016.

Interaction terms between year and each of the following predictors	Couple's STI[b] Adjusted OR (95% CI)		Couple's STI[d] Adjusted OR (95% CI)	
Wife's education				
- College or above	1.29	(0.68, 2.46)		
- Higher secondary	1.12	(0.63, 1.96)		
- Secondary	1.82*	(1.14, 2.88)		
- Primary	1.36	(0.99, 1.88)		
- Illiterate	Ref.			
Wife's employment	1.18	(0.90, 1.56)		
Husband's education				
- College or above	0.95	(0.54, 1.70)		
- Higher secondary	0.87	(0.51, 1.47)		
- Secondary	1.08	(0.70, 1.66)		
- Primary	1.06	(0.74, 1.52)		
- Illiterate	Ref.			
Husband's employment	1.97*	(1.10, 3.52)	2.02*	(1.13, 3.60)
Family wealth				
- Highest	2.08**	(1.21, 3.57)	2.60***	(1.72, 3.92)
- Fourth	2.07**	(1.28, 3.34)	2.52***	(1.67, 3.80)
- Middle	1.49	(0.99, 2.25)	1.69**	(1.14, 2.52)
- Second	1.27	(0.86, 1.88)	1.36	(0.93, 1.99)
- Lowest	Ref.		Ref.	
Family residence				
- Urban	1.12	(0.79, 1.59)		
- Rural	Ref.			

*p<0.05
**p<0.01
***p<0.001
OR = Odds Ratio
95% CI = 95% Confidence Intervals
Ref. = Reference groups for odds ratios

[a]Adjusted multivariate analysis for all predictors included in the table, including age, religion, and caste

[b]Multivariate analysis for SES variables (employment, family wealth) as predictors and adjusted to all predictors included in the table, including age, religion, and caste

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Table 5. Associations of likelihood of married couples, who reported STI or symptoms, seeking advice or treatment when they had STI/discharge/sore/ulcer and individual demographics and socio-economic status, 2006 and 2016.

	Husband's treatment or seeking advice for STI and symptoms (Multivariate) Adjusted OR (95% CI)		**Wife's treatment or seeking advice for STI and symptoms (Multivariate)** Adjusted OR (95% CI)	
Year 2016	0.50***	(0.40, 0.62)	0.88*	(0.78, 0.99)
2006	Ref.		Ref.	
Wife's age	1.02	(0.99, 1.04)	1.00	(0.99, 1.02)
Wife's education				
- College or above	1.33	(0.86, 2.06)	1.17	(0.86, 1.59)
- Higher secondary	1.31	(0.90, 1.92)	1.25	(0.98, 1.61)
- Secondary	1.09	(0.81, 1.47)	1.37**	(1.13, 1.66)
- Primary	0.92	(0.74, 1.14)	1.35***	(1.17, 1.55)
- Illiterate	Ref.		Ref.	
Wife's employment	0.99	(0.82, 1.19)	1.12	(1.00, 1.27)
Wife's religion				
- Hindu	1.14	(0.52, 2.53)	0.92	(0.54, 1.58)
- Muslim	1.50	(0.50, 4.50)	1.64	(0.79, 3.43)
- Christian	0.42	(0.15, 1.14)	1.18	(0.59, 2.38)
- Other	Ref.		Ref.	
Wife caste/tribe				
- Scheduled caste	1.85**	(1.20, 2.84)	0.77	(0.54, 1.09)
- Scheduled tribe	1.51	(0.78, 2.92)	0.85	(0.54, 1.35)
- Other backward class	1.12	(0.79, 1.58)	0.90	(0.71, 1.16)
- Others (none of them)	Ref.		Ref.	
Husband's age	0.99	(0.97, 1.01)	1.01	(0.99, 1.02)
Husband's education				
- College or above	1.00	(0.68, 1.47)	1.28	(1.00, 1.65)
- Higher secondary	0.87	(0.60, 1.27)	1.29*	(1.02, 1.63)
- Secondary	1.04	(0.77, 1.40)	1.23*	(1.01, 1.48)
- Primary	1.00	(0.78, 1.27)	1.24*	(1.05, 1.45)
- Illiterate	Ref.		Ref.	
Husband's employment	1.04	(0.74, 1.34)	1.09	(0.87, 1.35)
Husband's religion				
- Hindu	0.81	(0.37, 1.79)	0.75	(0.43, 1.30)
- Muslim	1.12	(0.38, 3.31)	0.49	(0.23, 1.05)
- Christian	1.38	(0.49, 3.86)	0.60	(0.29, 1.25)
- Other	Ref.		Ref.	
Husband caste/tribe				
- Scheduled caste	0.60*	(0.39, 0.91)	1.24	(0.87, 1.76)
- Scheduled tribe	0.69	(0.38, 1.24)	0.97	(0.61, 1.54)
- Other backward class	0.77	(0.54, 1.11)	1.05	(0.81, 1.36)
- Others (none of them)	Ref.		Ref.	
Family wealth				
- Highest	1.22	(0.86, 1.74)	1.91***	(1.51, 2.41)
- Fourth	1.18	(0.86, 1.74)	1.65***	(1.35, 2.02)
- Middle	1.20	(0.90, 1.60)	1.31**	(1.09, 1.59)
- Second	1.35*	(1.05, 1.73)	1.15	(0.95, 1.39)

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- Lowest	Ref.		Ref.	
Family residence				
- Urban	1.15	(0.92, 1.44)	1.07	(0.93, 1.22)
- Rural	Ref.		Ref.	

*p<0.05
**p<0.01
***p<0.001
OR adjusted for all variables included in the table
OR = Odds Ratio
95% CI = 95% Confidence Intervals
Ref. = Reference groups for odds ratios

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Figure 1 – An outline of the process of sample selection from India National Family Health Survey datasets. It describes the flow diagram from datasets of two survey waves to the final sample size used for multivariate analyses.

Figure 2 – A grouped bar chart of prevalence and 95% confidence intervals of married couple's past-year STI and symptoms in 2006 and 2016. The results are shown in five groups of those who reported having: STI, genital sore, genital discharge, either symptom of soreness and discharge, and having STI or any symptoms. There was an increase in prevalence across the five measures of self-reported STI and other STI-related symptoms from 2006 to 2016.

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Figure 1. Flow diagram of final sample sizes of married couples, India National Family Health Survey, 2006 - 2016.

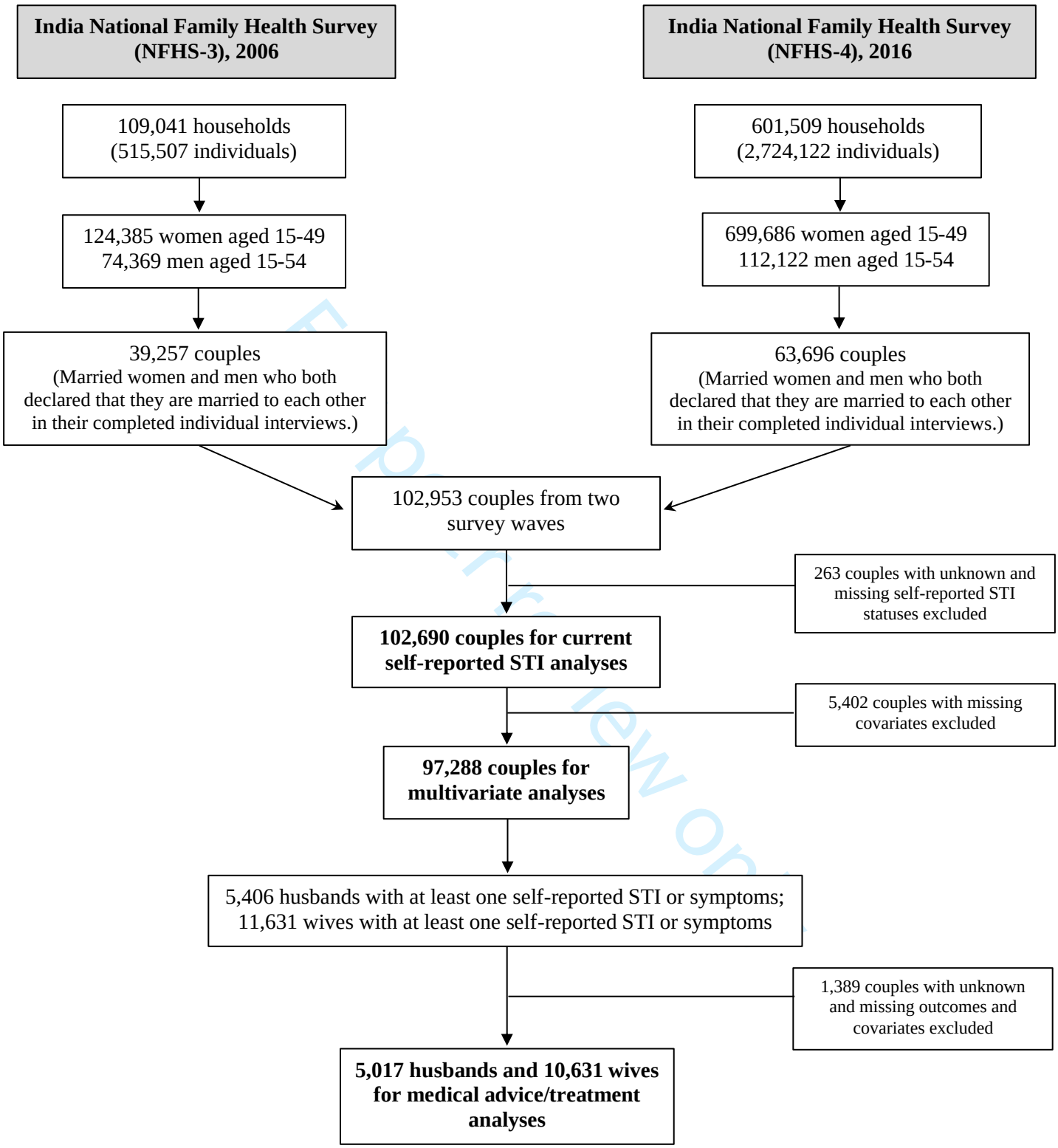
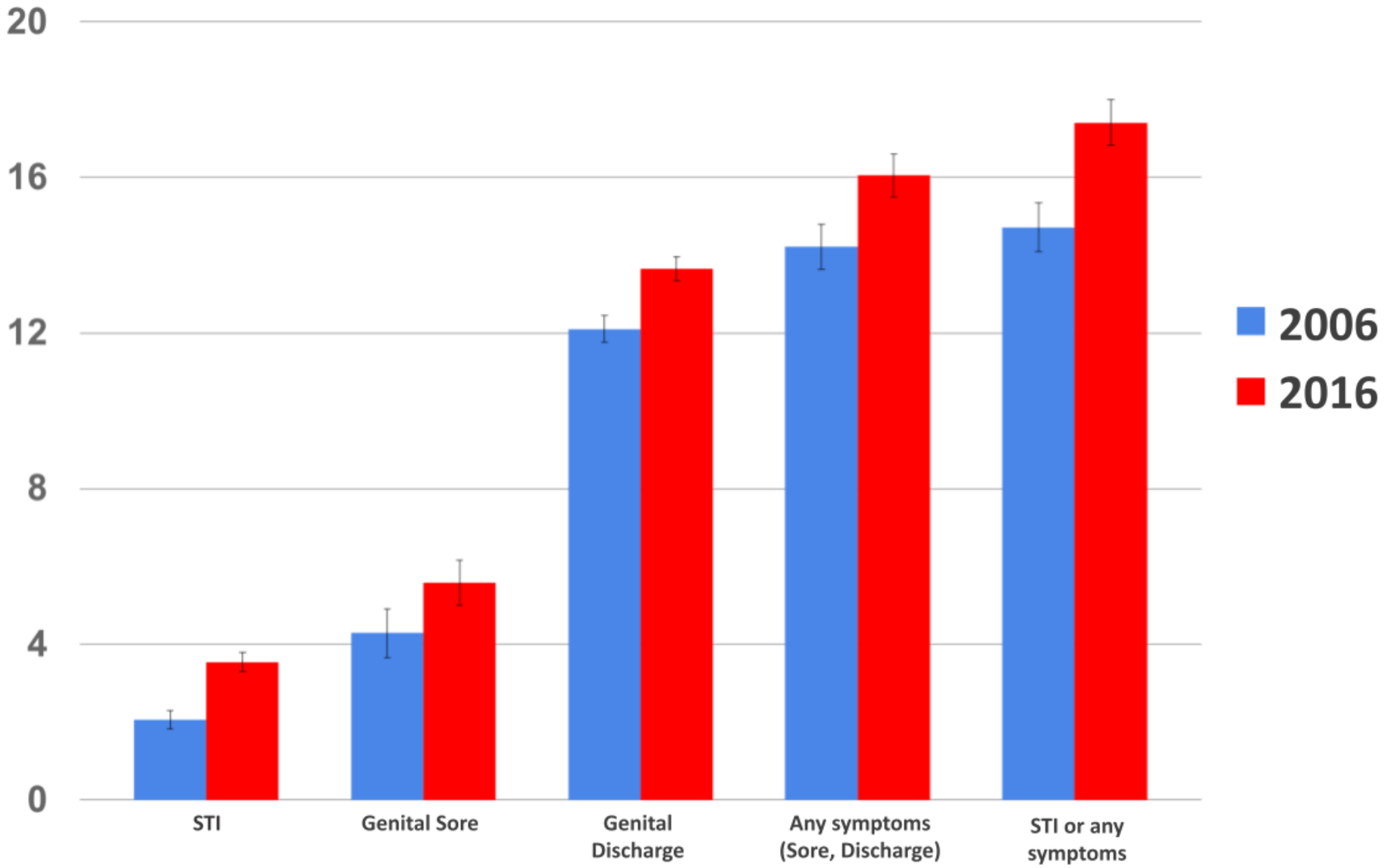


Figure 2. Prevalence (%) of married couple's recent self-reported STI and STI symptoms by years, 2006 and 2016.



STROBE Statement—Checklist of items that should be included in reports of ***cross-sectional studies***

	Item No	Recommendation	Page and Line No. from the Manuscript
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract	Pg 1, line 1-3
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found	Pg 1, line 14-34
Introduction			
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported	Pg 2, line 10-29
Objectives	3	State specific objectives, including any prespecified hypotheses	Pg 2, line 31-37
Methods			
Study design	4	Present key elements of study design early in the paper	Pg 3, line 35-46
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection	Pg 2, line 41-46; pg 3, line 1-5
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants	Pg 3, line 2-5
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable	Pg 3, line 7-29
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group	Pg 2, line 41-44
Bias	9	Describe any efforts to address potential sources of bias	Pg 3, line 10-19
Study size	10	Explain how the study size was arrived at	Pg 3, line 2-5
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why	Pg 3, line 7-33
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding	Pg 3, line 36-46
		(*b*) Describe any methods used to examine subgroups and interactions	Pg 3, line 36-46
		(*c*) Explain how missing data were addressed	Pg 3, line 2-5
		(*d*) If applicable, describe analytical methods taking account of sampling strategy	Pg 3, line 29-31
		(*e*) Describe any sensitivity analyses	N/A
Results			
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed	Pg 4, line 9; Figure 1
		(b) Give reasons for non-participation at each stage	Figure 1
		(c) Consider use of a flow diagram	Figure 1
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders	Pg 4, line 9-13; Figure 1

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		(b) Indicate number of participants with missing data for each variable of interest	Figure 1
Outcome data	15*	Report numbers of outcome events or summary measures	Pg 4, line 15-31; Table 2
Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included	Pg 4, line 33-46; Pg 5, 1-19; Table 3 and 4
		(*b*) Report category boundaries when continuous variables were categorized	N/A
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period	N/A
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses	Pg 5, line 21-46; Pg 6, line 1-4
Discussion			
Key results	18	Summarise key results with reference to study objectives	Pg 6, line 8-15
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias	Pg 7, line 2-20
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence	Pg 6, line 17-46
Generalisability	21	Discuss the generalisability (external validity) of the study results	Pg 6, line 38-46
Other information			
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based	Pg 7, line 37-40

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at www.strobe-statement.org.

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